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Journal of the Society of Arts.

FRIDAY, JUNE 13, 1856.

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EXTRA-ORDINARY MEETING.

Wednesday, June 11, 1856.

An Extra-Ordinary Meeting was held on Wednesday, the 11th of June, Joseph Glynn, Esq., F.R.S., in the chair.

The following Institution has been taken into Union since the last announcement:—

417. Lockwood, Mechanics' Institution.

The paper read was—

ON THE DRYING AND BURNING OF BRICKS.

By Humphrey Chamberlain, Draining Engineer, Kempsey, near Worcester.

In the preceding paper I arrived at that stage of the manufacture in which machinery may be considered to have rendered us all the aid that we require of it, and left the plastic clay formed into bricks. In proceeding with the manufacture, we have next, by means of evaporation, to get rid of the water with which it was necessary to work the clay for the purpose of making it ductile. The oldest system is that of laying the bricks, as moulded, on floors or flats. These are spaces of ground worked very smooth, of a slightly convex form, from six to ten yards wide, and of any desired length. The bricks are exposed on these flats until they are stiff enough to bear being removed by hand; they are then walled or hacked on each side of the floors, from six to twelve high, one row on another, with a space of from half to three-fourths of an inch between each brick, to allow a current of air between them. They are then covered with roofing tiles, or tiles made on purpose, and, in some instances, with straw; then left until they are sufficiently dry for the last process,—burning. In some works the bricks are hacked as they are made, by the use of pallet-boards, and as explained in the making by the machine. This is the general system of the present day, and the reason why the manufacture is restricted to one season of the year. For during the winter, the late autumn, and the early spring, on account of the lower temperature of the atmosphere, shorter days, and absence of sun, the bricks would be a very long time in drying, and a frost would totally destroy all containing any moisture. In dull, damp seasons this process is very slow and tedious. The bricks are also much deteriorated in quality from the washing of the rains on the floors, or against the ends of them in the hacks. In such seasons, a brickmaker, in order to get over his usual amount of work, often requires double the extent of drying-ground, each moulder occupying about half an acre of land for this purpose only; and the extent of ground required gives to brick-works near London the title of brick-fields, and in the country that of brick-yards. Bricks are sometimes dried in hacks under sheds, but for large works, in which machinery is used for making them, the quantity of shedding required would be so great, that it would be better to erect more improved constructions.

When the brick is partially dry, and quality is a consideration, it is the practice in some works, where hand-making is adopted, to dress a portion of the bricks by hand with boards called tappers, or by means of a small machine called a brick-press, of which there are many excellent ones made. The brick is placed in a metal mould, and by means of a powerful leverage is subjected to considerable pressure, which gives it a very smooth face, and produces the best front bricks. Some of these machines have single, and others double moulds. I prefer the latter, as, while one brick is being pressed, the brick previously dressed is removed, and another fed in, which saves much labour and time over the single-mould press. Although these machines do not exert a tithe of the force employed by the dry clay making machines, we often see the bricks pressed by hand only, when made from plastic clays, blown to pieces, and their outer surfaces shelled off, from their not being able to be dried entirely throughout. Brickmakers should select their most loamy earths for making bricks which are afterwards to be pressed for front stocks. Pressed bricks must be thoroughly dried previously to their being placed in the kiln. A good machine produces bricks of such a quality as renders the above process unnecessary.

The drying of bricks ready for burning is a matter of great importance, and requires more attention than it generally receives. From hand-made bricks we have to evaporate some 25 per cent. of water before it is safe to burn them. In a work requiring the make of 20,000 bricks per day, we have to evaporate more than 20 tons of water every 24 hours. Hand-made bricks lose in drying about one-fourth of their weight, and in drying and burning about one-third. The average of machine bricks—those made of the stiff plastic clay—do not lose more than half the above amount from evaporation, and are, therefore, of much greater specific gravity than hand-made ones.

The artificial drying of bricks is carried on throughout the year uninterruptedly in sheds having the floor heated by fires, but this can only be effected in districts where coal is cheap. The floors of these sheds are a series of tunnels or flues running through the shed longitudinally. At the lower end is a pit, in which are the furnaces; the fire travels up the flues under the floor of the shed, giving off its heat by the way, and the smoke escapes at the upper end, through a series of (generally three or four) smaller chimneys or stacks. The furnace end of these flues would naturally be much more highly heated than the upper end near the chimneys. To remedy this, the floor is constructed of a greater thickness at the fire end, and gradually diminishes to within a short distance of the top. By this means, and by the assistance of dampers in the chimneys, it is kept at nearly an equal temperature throughout. Bricks that will bear rapid drying, such as are made from marly clays or very loamy or siliceous earths, will be fit for the kilns in from 12 to 24 hours. Before the duty was taken off bricks, much dishonesty was practised by unprincipled makers, where this drying could be carried on economically. Strong clays cannot be dried so rapidly. These sheds are generally walled round with loose bricks, stacked in between each post or pillar that supports the roof. The vapour given off from the wet bricks, rising to the roof, escapes. This system of drying is greatly in advance of that in the open air, for it produces the ware, as made, without any deterioration from bad weather, but the expense of fuel to heat these flues has restricted its use to the neighbourhood of collieries. In 1845 I turned my attention to the drying of bricks, and carried out experiments in drying the ware with the waste heat of the burning kilns. The caloric, after having passed the ware in burning, was carried up a flue raised above the floor of the shed, and gave off its spent heat for drying the ware. A model of my kiln and drying shed was exhibited at the Royal Agricultural Society's meeting at Northampton in 1847, by Mr. Bullock Webster, who was so pleased when witnessing it at work, that he asked my permission to have the model made to be exhibited. Although this kiln was most useful in proving that the waste heat of a burning kiln is more than sufficient to dry ware enough to fill it again, I was obliged to abandon it on account of the construction of the kiln not being good. This difficulty is now entirely removed, by a kiln which I shall have to describe presently.

Another system of drying is in close chambers, by means of steam, hot water, or by flues heated by fire under the chambers. I will, therefore, briefly describe the steam chamber as used by Mr. Beart. This is a square construction, or series of tunnels or chambers, built on an incline of any desired length; and at some convenient spot near the lower end is fixed a large steam boiler, at a lower level than the drying chamber. From the boiler the main steam pipe is taken along the bottom or lower end of the chamber, and from this main, at right angles, run branch pipes of four inches diameter up the chamber, two feet apart, and at about three feet from the top or arch. From there being so close and shallow a chamber between the heating surface of the pipes and the top, and so large an amount of heating surface in the pipes, the temperature is soon considerably raised. At the top and bottom ends are shutters or lids, which open for the admission of the green ware at the upper end, and for the exit of the dry ware at the lower end of the chamber. Over the steam pipes are fixed iron rollers, on which the trays of bricks, as brought from the machine, are placed, the insertion of one tray forcing the tray previously put in further on, assisted in its descent by the inclination of the construction. The steam being raised in the boiler, flows through the main into those branch pipes in the chamber, and from the large amount of exposed surface becomes condensed, giving off its latent heat. From the incline given to the pipes in the chamber, and from the main pipe also having a fall towards the boiler, the whole of the warm water from the condensed steam flows to the boiler to be again raised to steam, sent up the pipes, and condensed intermittently. The steam entering at the lower end of the chamber, it is of course warmer than the upper end. Along the top end or highest part of the chamber is a series of chimneys and windguards, through which the damp vapour escapes. The bricks from the machine enter at this cooler end charged with warm vapour, and as the make proceeds, are forced down the chamber as each tray is put in. Thus, those which were first inserted reach a drier and warmer atmosphere, and on their arrival at the lower end come out dry bricks, in about 24 hours, with the strongest clays. In some cases the waste steam of the working engine is sent through these pipes and condensed. Bricks will dry soundly without cracking, &c., in these close chambers, when exposed to much greater heat than they would bear on the open flue first described, or the open air, from the circumstance of the atmosphere, although very hot, being so highly charged with vapour. In practice these steam chambers have proved many principles, but they are not likely to become universal, for they are very expensive in erection on account of the quantity of steam pipes, and involve constant expense in fuel, and require attention in the management of the steam boiler; but their greatest defect is the want of a current of hot air through the chamber to carry off the excess of vapour faster than is now done. The attaining a high degree of temperature in these chambers is useless, unless there is a current to carry off the vapour. Why should this piping be used, or steam at all, when we have a large mass of heat being constantly wasted, night and day, during the time the kilns are burning? and after the process of burning the kilns is completed, we have pure hot air flowing, from 48 to 60 hours, from the mass of cooling bricks in the kilns, free from carbon or any impurities; this could be directed through the drying chambers, entering in one constant flow of hot dry air and escaping in warm vapour. The waste heat during the process of burning can be taken up flues under the chamber, and thereby all the heat of our burning kilns may be economised, and a great outlay saved in steam pipes, boilers, and attention. It must not be forgotten also, that so large an atmospheric condenser as the steam chamber is not heated without a considerable expenditure in fuel. This drying by steam is a great stride in advance of the old flued shed, but practical men must see the immense loss incurred constantly from this source of the spent heat of the burning kilns, and that by economising it, an immense saving will be effected in the manufacture. The kilns are constructed as near the lower end of these chambers as convenient.

A kiln for attaining the object of the one I built in 1846 is now at work at Epsom, at Mr. Hand's brickworks; but with this difference, that the smoke is consumed. The drying shed is kept quite close, that the hot flues may raise the temperature so high as to dry the ware. In this kiln the heated gases escape from the top, after passing up through the ware, into a flue, and are carried to the ground, and thence into the drying shed, which is a very large construction in proportion to the size of the kiln, and holds nearly sufficient ware to fill four kilns. In this shed the heat passes up a hollow wall, about six feet high, and after running through the length of the shed on one side, returns down a similar flue on the opposite side of the shed, and is again carried to the kiln, through the bottom of which it passes in two close flues between the three kiln-furnaces, with the exception of small apertures through which the heat enters to consume (as I am informed) the smoke; but I have not been able to see it at work, and therefore cannot speak on this point. I fear there must be a loss of heat to consume this smoke, which has travelled some 300 or 400 feet; this should be done in the furnace before it enters the ware, and so be economised. From these return flues the spent gases rise up a shaft at the end of the kiln. One result of carrying this return flue through the kiln, is the attaining a great draft or suction in the flues to carry off vapour. If Mr. Hands were to erect three more kilns, and so work four into his present drying-house, he could always have it highly heated; as one kiln would be burning and another cooling continually, while the other two were being respectively filled and emptied. By this means he would realise a much larger return from his spent heat. He has now to raise the temperature of the whole construction each time he burns, from that of the atmosphere to a drying heat of about 90 degrees.

The burning of bricks is exposing the clay to such a degree of heat as to change its character from a merely absorbent lump of dry earth to a hardened, indestructible, partially vitrified mass, or artificial stone, which will withstand the action of the atmosphere. The effect of fire on clays, or brick-earth, varies with the proportion and number of earths and salts of which they are composed, and the different per centage they bear one to another. Clay, or pure alumina, is infusible, but on exposure to great heat, contracts greatly in bulk. It is this property which regulates the action of Wedgwood's pyrometer. Alumina combined with silica, or alumina combined with lime, will withstand the most intense heat which can be obtained in a furnace; but if we mix these three earths, alumina, silica, and lime together, they then melt at a very low heat; the lime acting as a flux on the silica; and, according to Dr. Ure, in his Dictionary of Arts, the more readily the nearer the mixture approaches the following proportions, viz.:—Alumina ⅕, lime ⅕, and silica ⅗; by adding two parts more of sand, it becomes infusible. The Devonshire and Dorsetshire plastic clays are composed of silica ¾, and alumina ¼; they burn very white, and form the basis of earthenware.

The clays and marls generally made into bricks contain protoxide of iron. If a clay has a large per centage of iron, and a small per centage of lime, the silica and alumina, the body of the ware, will withstand a much higher temperature than is required to flux the iron. By attaining a sufficient heat the iron melts and completely cements all the pores, giving the brick a metallic coating; so that on being immersed in water these bricks are very slightly absorbent. The bricks made from London clay, about Uxbridge, and burnt in what are called close fire-clamps, take from 10 to 15 degrees Wedgwood to burn them sufficiently hard; the fire-bricks of Stourbridge take 85 degrees; the vitrified blue bricks of Staffordshire 95 degrees; and the vitrified bricks of North Wales require

120 degrees Wedgwood, or the same heat as an iron smelting furnace. It will be seen, from what I have stated, with how varying a material we have to deal. In one case we have to attain the heat of the smelting furnace, and in another we are not much to exceed a low red heat, or the whole of the kiln or clamp would become one lump of useless slag. Clays contract in the burning as well as in drying; in order to correct this, therefore, it is desirable to work up sufficient silicates, as loam, sand, &c., with strong clays or very plastic earths. A good tile clay, that will dry and burn soundly in a thin body, or a perforated brick, will fly in the fire in so large a mass as a solid brick.

In the case of refractory clays, if, as soon as the kiln is burnt, a little common salt is thrown into the fires, from the intense heat of the interior it is immediately volatilized; the kiln then being closed up, and the fumes retained, an effect is produced on some clays of glazing the bricks, and on others of changing their colour, particularly if the clay is charged with iron, to a much darker hue, the soda acting as a flux on the iron and silica; for the effect of the chlorine we must appeal to the chemists. Stone ware, or Dorsetshire clay, takes a salt glaze. Salt must be very cautiously used, until its action on the clay is proved, for brick earth becomes much more fusible when exposed to the vapours or gases from salt, and will be in danger of being melted. The use of sulphurous coal for brick-burning is esteemed by many makers, from the bricks having a harder appearance and better colour. The colour to which bricks are burnt, varies throughout the country. In London the white bricks are esteemed, although from the smoky atmosphere they soon obtain a different hue. Suffolk, Devonshire, Dorsetshire, Cambridgeshire, and Essex, produce white bricks of the best quality. The general colour of bricks throughout the country is red, but in Staffordshire, Shropshire, Worcestershire, and other coal districts, they are what are termed blue bricks, and are of the colour of cast iron.

The chemical action of salts thrown into the fires of brick-kilns for the purpose of fluxing, or burning the ware at a lower temperature, or giving a better colour or appearance to the bricks, has not been sufficiently experimented on. This should be undertaken by the chemist, as the brickmaker, without his assistance, may try many useless experiments.

To explain fully the various processes of firing adopted for the different classes of earths, or more generally the different districts of the country, would occupy more time than the limits of this paper will allow. Each county adopts a distinct mode; and in some counties there are used two or three different constructions of kilns, or principles of firing the ware. I will, therefore, briefly allude to the general systems adopted, and more particularly explain those improvements which have taken place, and stood practical proof of their utility. A subject which has formed the basis of 230 patents cannot be fully explained in so brief a space. Besides this there are many improvements not protected by patents.

For burning bricks, we have to employ the utmost care and attention in exposing them to as high a heat as they can stand without endangering their melting. If they are not sufficiently burnt, they will be very absorbent, and will retain sufficient moisture for a frost to destroy them.

The burning is carried out on two principles:—1st. In the neighbourhood of London and Manchester, by what are termed close fire clamps; that is, with as little draft as possible, or by a smouldering fire which occupies a month or six weeks in burning, having the fuel spread in layers between the bricks. The other system is by a draft of hot air or flame from furnaces or fire-holes in square or circular buildings, called kilns.

Of these there is an endless number of constructions; some nearly approach the close fire clamps, having a very slow draft, and take a week or nine days to burn them. Others have an increased draft, and take four or five days; and the more recent constructions effect the desired object in from forty-eight to seventy-two hours.

The close fire clamp is the favourite system around London and Manchester for burning bricks, which arises from these large populous cities supplying the brickmaker with a very cheap fuel in the shape of the refuse ashes from the houses and the manufactories, and also from the clays in these districts taking little fire to burn them. The London makers not only burn by layers of the ashes between the bricks in the clamp, but, as I before mentioned, add in the making, about 30 per cent. to the clay before it is moulded. Around Manchester, ashes are not used in making the bricks, but only in burning them. I think it quite superfluous to describe the setting or constructing these clamps; it would occupy much time, and the fewer we have of them, the better bricks will be supplied. But the principle is to stack the bricks close together, and to check the draft as much as possible, the fuel being intermixed with the ware. The wind is often very troublesome with clamps, and drives the fires to one side, by which that is over-burnt and the other side almost useless from not being burnt enough. I have not had any experience in these clamps myself, but I am informed by those practically acquainted with them, that the inferior (that is, the over and under-burnt) bricks are often in a proportion of from 30 to 50 per cent.; and these have to be sold at a reduced price. This irregular firing produces the numerous qualities of bricks which I described in my previous paper. All are made equally well, but are destroyed by the unequal heats to which they are exposed. The heat at which the bricks are burnt, varies in the London close fire clamps from 5 to 20 degrees. That the close fire clamp is the worst system of burning bricks few can doubt; and it would not be so tenaciously adhered to around London and Manchester, but from the supply of ashes being so great and so cheap. As a proof that the system is not good, the brickmakers in the collieries all use kilns, even where they have in their works refuse coal free of cost. But they cannot sell their bricks unless they are of good quality; they, therefore, use the kiln with a quick draft.

On visiting the brickworks at Epsom a few weeks since, to inspect the kiln which I have described to you, I was quite convinced that my opinion was right with respect to close fire clamps. The bulk of the bricks made in these works are burnt in the clamps, and a portion in the kiln. The most casual observer could not but be struck with the difference of the ware. Before I leave the subject of close fire clamps, I may mention that the London ashes could still be used by their being ground up fine amongst the clay; and then a very small quantity of fuel in the furnace of an improved kiln would burn the bricks of one uniform quality, and enable the waste heat to be economised for drying the green ware. The ashes, as they are now used, have their particles too large; and these, on being consumed, leave the bricks full of cells, and less compact and solid than other bricks.

The burning kilns are generally rectangular brick constructions, either open at the top or arched over, but some are circular buildings, or cupolas, called "ovens." It would take a whole evening to describe every one, and the different systems adopted in each; I will, therefore, only briefly explain the burning of an improved square kiln, and of a round one. The construction of the kilns cannot be correctly explained without drawings. The square kilns for large works, as erected by Mr. Beart, are built in pairs, to save one wall; they have the furnaces along one side, and the centre wall supports the two arches of the kilns. When they are thus built together, one is burning while the other is being discharged and filled, the cool kiln acting as a buttress to the burning one. The late Dr. Cother, of Gloucester, built a pair of these kilns under one arch. The bottom of the kiln is constructed with furnaces every five feet from centre to centre, and built with fire bricks. Above the fires, and about five feet from the bars of the furnace, is the floor of the kiln, supported on walls running through the length of the kiln, about 4 inches apart, and in these walls are arches at each furnace. The walls are tied together by the lattice work of the floor of the kiln, and the ends of the bricks, forming the open floor, are kept about three inches from each other. Through these small holes the flame from the furnace enters the goods to be burnt. The height from the open floor to the top of the arch is about 15 feet, and the vertical walls are from 12 to 14 feet apart. Thus a large space is allowed, as they can be built of any desired length. These kilns are constructed to hold from 50,000 to 200,000 bricks each, and are capable of being burnt from 18 to 20 times in a year. The arches of the kilns have a row of small chimneys, about three feet high and five feet apart, built down the centre, and a similar number on each side, through which the waste heat and gases escape.

The first process is to fill the kiln, which is called "setting." The bottom rows of bricks are kept wide apart over the floor, to allow the flame to enter more freely. On these are placed one or two rows of bricks, crossing the course on the floor, and about ¾ of an inch apart. Every one or two courses are then crossed, so that the fire has to pass through a series of net work, formed in the setting of ¾ inch squares. When the kiln is filled, the entrance, called the "wicket," is built up close with burnt bricks, and plastered over with loamy clay. The fires are then lighted in the several furnaces, and for 24 hours are allowed to burn very gently, but gradually increased, air being admitted, that the draft or warm current may drive off the steam as fast as it is formed, for bricks cannot be *thoroughly* dried previously to their being stacked in the kilns. When the steam ceases to flow from the top chimneys, the fire is gradually increased, and the heated gases flow with greater velocity through the ware. At this time the judgment of the burner is called into requisition, for if his furnace should become too hot, he may vitrify the bottom bricks, while those at the top of the kiln, 20 feet from the fire, would be quite unburnt. This he prevents by opening his furnace lids, and allowing a current of air to enter sufficient to cool his furnace. He then again closes the lid, in order to attain what heat he can safely use. These operations of heating and cooling are continued until, on looking at the top chimneys of his kiln, he sees that he has attained a sufficient heat. After this he gives the kiln a few hours more fire, but gradually admitting more air, which begins to lower the temperature of the bottom part, and, from the increased draft, carries the heat to the arch, and thoroughly burns the top bricks. I have often seen these top bricks, 20 feet from the fires, harder burnt than those on the floor of the kiln, within 5 feet of the fire. After the burning is completed, the fire doors are shut to prevent the kiln cooling too rapidly, and for two or three days it is pouring off to *waste* an immense amount of heat, free from all impurities. When the kiln is cool, the wicket is taken down, and the ware drawn out for use. With a good burner the bricks will all be of equal quality, and, if well made, will all command the highest price, not a moiety only, as in clamp burnt bricks.

The common brick kiln is a rectangular building, generally open, but sometimes arched over. In the side walls and opposite to each other, are built fireplaces, or holes for the insertion of the fuel. The furnaces are formed in the setting of the kiln with unburnt bricks, and above these the kiln is filled as above described. In these kilns, from the raw ware forming the furnace, the flash of the flame, from the fires in the walls, too often vitrifies and destroys the nearest bricks. In the open kiln, as the fire or heat reaches to the top, the fireman soils or earths it down, which throws the draft to another part more backward; and, as it continues to rise, he proceeds with this operation until all the top is earthed in; he then continues the firing until the whole has sunk, by the contraction of the clay in the fire, to the desired depth. The fire-holes are then stopped up with mud, and the kiln is left to cool gradually. If the air were admitted too rapidly while the kiln was at this intense heat, it would cause bricks, made with strong clays to fly to pieces like glass; it is, in fact, the process of annealing. Cooling too quickly also affects, in many clays, the colour of the bricks.

Temporary kilns are constructed in the country with unburnt bricks, and called clamps. In Staffordshire, the bricks are burnt in small round kilns, called ovens, which hold from 7000 to 8000 bricks each; these are burnt from fire in the walls round the ovens, and the raw ware is set in, so as to form a flue from each fire, to direct the flame to the centre. These ovens burn very quickly, and a most intense heat can be obtained in them.

I will now more fully describe a principle of burning which I have had in practice for the last six years, and which I can therefore recommend with great confidence. The great object in brick-burning is to attain a sufficient heat to thoroughly burn the ware with as small a consumption of coal as possible; and with nearly an equal distribution of the heat over all parts, so that the whole of the ware, being subjected to the same temperature, may contract equally in bulk, and be of one uniform colour throughout. The advantage is also gained of burning in much less time than in the old kilns, which, on an average, took a week; and the management is so simplified that any man, even though not at all conversant with the manufacture, after he has seen one kiln burnt, will be able to manage; and the last, though not least, advantage is, that of delivering up to us the waste heat at the ground level, or under the floor of the kiln, to be used in drying the green ware, or in partially burning the next kiln.

Hitherto the heat has been applied by a series of fire-places, or flues and openings round the kiln, each exposed to the influence of the atmosphere; and in boisterous weather it is very difficult to keep the heat at all regular, the consequence of which is, the unequal burning we often see. The improvements sought by experimentalists have been the burning the goods equally, and, at the same time, more economically. These are obtained by the patent kilns, as improved by Mr. Robert Scrivener, of Skelton, in the Staffordshire Potteries. The plan is both simple and effective, and is as follows:—A furnace is constructed in the centre of the kiln, much below the floor level, and so built that the heat can be directed to any part of the kiln at the pleasure of the fireman. First, the heat is directed up a tube in the centre to the top of the oven or kiln, and, as there is no escape allowed to take place there, it is drawn down through the goods by the aid of flues in connection with a chimney. Thus, all the caloric generated in the furnace is made use of, and, being central, is equally diffused throughout the mass; but, towards the bottom, or over the exit-flues, the ware would not be sufficiently burnt without reversing the order of firing. In order to meet this requirement there is a series of flues under the bottom, upon which the goods are placed, with small regulators at the end of each; these regulators, when drawn back, allow the fire to pass under the bottom, and to rise up among the goods which are not sufficiently fired, and thus the burning is completed. By means of these regulators the heat may be obtained exactly the same throughout; there is, therefore, a greater degree of certainty in firing, and a considerable saving of fuel, with the entire consumption of the smoke. From the fire or draught being under command, so as to be allowed either to ascend or descend through the ware during the time of burning or cooling, the waste caloric can be economised and directed through the adjoining kiln in order to partially burn it, or be used in drying off the raw wares on flues or in chambers. I have found the saving of fuel in these kilns over the common kiln, 50 per cent.; and to give an idea of the facility with which they can be worked, it is common for my men to fill the kiln, burn, cool, and discharge it in 6 days. But the time I usually allow is, to have each kiln set, burnt, and drawn in seven days.

I have obtained from the manager of the Lilleshall Company a report as to how these kilns answer for burning the Staffordshire blue bricks, which I will read to you:

Prior's Lec, near Shiffnall, May 13, 1856.

Sir,—I have the superintendence of two sets, of four ovens each, at the Lilleshall Company's works here. Each of these ovens will contain from twelve to thirteen thousand bricks, and require from seven to eight cwt. of small coal to burn each thousand, the time occupied in burning being about twenty-four hours. This short time is accounted for by the spare heat passing from one oven to another, and thoroughly drying the bricks before the fire is put in the grate. One set of these ovens has been at work for the past five years; the only repairs required in that time being the tube, and this is trifling. Not one grate-bar has had to be replaced. The old brick ovens at this work would contain about 7,000 bricks; one ton of coal per thousand was required, and three days and two nights to burn them. Unless there are some greater improvements than Mr. Scrivener's out in brick ovens, his certainly must rank No. 1.

Yours truly,
WM. TIPTON.

H. Chamberlain, Esq., Kempsey, Worcester.

In these works the saving of fuel is 60 per cent., and of time 36 hours.

To sum up the manufacture of bricks on the most improved system, the whole works should be under one roof, and only occupy a fraction of the space devoted to this manufacture in the field. The brick manufactory may be a square construction, a fourth of which, across the top, would be occupied by the steam-power mills and machines, with an allowance for working room; one-half would be used for drying the ware, and the remaining quarter for kiln-room. The clay should be brought into the works from the pit by trucks, on a light railway, of which some excellent ones for the purpose are manufactured by Mr. Crosskill, of Beverley, the celebrated agricultural implement-maker. It should then be manufactured into bricks by machinery, and delivered to a drying chamber, or laid on open flues (the latter being the cheapest in construction), in order to be dried, the flues or chambers being heated by the waste heat of the burning kilns. As soon as the bricks are dry, they should be stacked in the kiln, burnt, and delivered out, at the opposite end of the manufactory to that at which the raw clay entered, ready for use. This can be done in from eight to nine days from the time when the clay first entered the works; being a very little more time than is occupied in burning alone in many districts.*

To attempt to give the cost of manufacturing would only mislead. The largest item is labour, the cost of which varies so much between manufacturing and agricultural districts. The next is coal or fuel for burning, which ranges from 3s. to 20s. per ton, according to the district of country. Again, one clay requires a large expenditure of fuel to be used, in order to attain the most intense heat; while another will burn sufficiently hard at about 10 degrees Wedgwood. The consumption of coal for burning bricks varies with the clays, from 3 to 20 cwt. per 1,000.

There are but very few places having much demand for bricks where the trade is monopolised. Competition prevents the brickmaker realising more than a reasonable profit for his industry and risk in manufacture.

Taking the duty off bricks has led to many improvements in the manufacture of them. We could not have used drying chambers, as the excise officer would not have been able to count the bricks. Nor could the bricks have been taken to the kilns from the dry-clay machines, as the duty was charged on the raw ware.

It was expected that, on the removal of the duty, ornamental bricks would have become a general manufacture, but this is not likely to be the case with machine-made bricks, for the reason I gave in my paper on the making, from the clay not being able to be expressed through dies with edges sufficiently sharp, on account of the large amount of friction. The attempt to mould by machines would require such quantities of large expensive moulds as would raise the price, to remunerate the manufacturer, so high that he could not compete with stone. After these ornamental blocks of clay have been moulded, it is necessary that they should be all exposed to the same heat in the kiln, as one block may contract so much more than another, that on their being placed in a building, all truth in the outline would be lost, and the appearance would be unsightly. I think architects, builders, and brickmakers will be unanimous on this point, that the great aim should be to improve the quality of the brick, and leave the production of the ornamental decorations of our buildings to the potter, as a distinct manufacture.

The smooth bricks used over the doors and windows of many houses are produced from very siliceous earths, which when burnt are so soft that they can readily be rubbed on a stone to any desired angle and face; they are called "rub-and-gage" bricks. Clays of this class, which are composed of sand and a very small portion of alumina, are manufactured into fire-bricks, and are called Windsor fire-bricks.

Another very siliceous earth, the deposit of the tide at Bridgewater, is moulded into bricks for cleaning knives, called Bath bricks, though made only at Bridgewater.

Before concluding this subject, I may mention that for the last few years we have been constantly informed through the press of the wonderful pressure the hollow and perforated bricks will sustain more than the solid ones. I believe these experiments have all been carried out with a machine-made hollow or perforated brick against a hand-made solid brick. The perforated brick being manufactured from stiff clay, by great pressure, is of a much higher specific gravity than the hand-made one, which was manufactured from soft mud, and having undergone excessive evaporation, was consequently very porous. Nor would these experiments be fair, even if a machine-made solid brick were tested with a machine-made perforated one, unless they had been both manufactured from the same lot of clay, and burnt in the same heat; for five degrees difference in the firing of the bricks would considerably affect the pressure which they would sustain.

Mr. Beart has kindly supplied me with a copy of the report on the weight required to crush his perforated brick made at Arlsey, and commonly used in London, and a London stock-brick, which I will read to you:—

"*Experiments testing the relative bearing powers of perforated and solid bricks, by hydraulic machine, at the works of Messrs. Cubitt and Co., 10th November, 1853.*

"Experiment No. 1.—Perforated bricks from the works of Messrs. R. Beart and Co., Arlsey, somewhat red in colour, were subjected to a pressure of sixty tons. When removed, one brick was cracked in the middle, the other perfectly sound.

"No. 2.—Paviours. These were subject to a pressure of 60 tons, but both bricks were found considerably broken.

"No. 3.—Best London stocks. These were crushed to fragments under a pressure of 37½ tons.

"No. 4.—Perforated bricks from the Arlsey works, differing from No. 1 in being white instead of red. Removed entire, after the full weight of 60 tons had been applied.

"In each case, two bricks were used cemented together on the flat or bearing surface, and the test limited to 60 tons, the machine not being adapted to a greater force without danger of its giving way.

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* The quality of bricks depends on the fineness of division of the particles, the proper admixture of the earths and their thorough amalgamation, the closeness or compactness into which they are worked, and finally the having been exposed to a sufficient heat to render them indestructible from exposure to any change of atmosphere.

"The results proved the greater resisting property of perforated over solid bricks; thus showing their special fitness for large buildings and other works where there is great superincumbent weight."

As I had never heard of any report which I considered an accurate test, I had a heap of clay of equal quality manufactured by the machine before you, one-half into solid and the other half into perforated bricks. When dry, they were burnt together in the same part of the kiln, and on six bricks of each sort I placed pyrometers, so that the result was that they were all burnt in equal heat of 30 degrees Wedgwood. I will now read the report of Messrs. Horner and Molesworth, the civil engineers, of Beaufort-buildings, in the Strand, who have been kind enough to test for me the power required to crush these bricks by hydraulic pressure:—

"*Report on Experiments to determine the Relative Strength of Solid and Perforated Bricks.*

13, Beaufort-buildings, Strand,
June 10th, 1856.

"Sir,—In accordance with your request we have instituted a series of experiments to determine the relative strengths of solid and perforated bricks. To do this, we have deemed it necessary to expose the bricks experimented upon to a transverse as well as a crushing strain. From the results which have been obtained from similar experiments made by Mr. Cubitt and Sir John McNeill, we have every reason to believe that in those trials the *machine*-made perforated brick was tested in comparison with the *hand*-made solid brick, which of course resulted in favour of the machine-made brick; hence the inference has erroneously been drawn that the perforated brick is stronger than the solid. If, however, the comparison is made between machine-made bricks only, it will be found that such is not the case, the solid brick being much stronger than the perforated, as our experiments incontestibly prove.

"We have also made experiments with the London hand-made stock-brick, as well as the Staffordshire brick, also made by hand.

"The experiments were made with a 9-inch hydraulic press; the plunger by which the pressure was applied was one inch in diameter, and the weight was suspended to a lever, which multiplied the power 15 times. In applying the transverse strains, however, a shorter lever, which only multiplied the power by 5, was used. The bricks subjected to a crushing force were faced, so as to remove all inequalities; they were then bedded on a sheet of thin lead, and another sheet placed upon them.

"The pressure was communicated by a cast-iron plate, so arranged as to adjust itself to the brick, and distribute the pressure uniformly over the whole surface. The weights were carefully applied, and allowed to come to a full bearing before more were added.

"In exposing the bricks to a transverse strain, the supports were placed two inches apart, and the weight gradually applied to the centre by means of a spring balance.

"The results of the experiments are shown in the annexed tables:—

Bricks exposed to Crushing Strain.

No. of Expt.	Description of Brick.	How made.	Weight of Bricks.	Temp. of Kiln.	Crushing Weight.			
			lbs.		tons.	cwt.	qr.	lbs.
1	Worcestershire, perforated......	Machine	6	30 W*	45	3	0	0
2	Ditto solid.........	Machine	8¾	25 ,,	52	14	3	0
3	Ditto solid.........	Machine	8¾	30 ,,	117	5	0	0
4	Ditto perforated.	Machine	6	30 ,,	47	17	1	11
5	Lond. stock solid	Hand.	5¾		13	3	0	0

* Wedgwood.

Bricks exposed to Transverse Strain.

No. of Expt.	Description of Brick.	How made.	Weight of Bricks	Temp. of Kiln.	Breaking Weight.			
			lbs.		tons.	cwt.	qr.	lbs.
6	Perforated Wors.	Machine	6	30 W.	3	15	2	20
7	Solid ditto.........	Machine	8¾	30 ,,	9	3	2	19
8	Perforated ditto	Machine	6	30 ,,	3	5	2	5
9	Perforated ditto.	Machine	6	30 ,,	2	3	3	15
10	Solid Staffordsh.	Hand.	9½		2	4	0	19
11	Solid ditto.........	Hand.	9½		4	8	0	5
12	Solid Worcester.	Machine	8¾	30 ,,	9	17	0	19

"In experiments Nos. 3 and 4, the cast-iron plates through which the pressure was communicated broke with the final strain.

"The brick used in experiment No. 5 was not faced, and as it was 'dished' on the upper surface, the pressure was not uniformly distributed over the surface.

"The bricks termed Worcestershire are those supplied to us by you from the works of the Earl of Coventry.

"We have the honour to be, Sir,
"Your obedient servants,
"HORNER AND MOLESWORTH,
"*Consulting Engineers.*

"H. Chamberlain, Esq."

In conclusion, I much regret that this subject has not fallen into abler hands. I have endeavoured to explain it as concisely and practically as I could in the brief space of time allotted to so wide a subject.

Many inventions and many improvements, I know, are being practically worked, in different parts of the country; but if I had entered on all, the papers would have been a mere catalogue of inventions connected with the brick manufacture.

I fear, also, that I have not explained these matters with sufficient clearness, but I must solicit your indulgence, and plead as my excuse that I am more accustomed to carrying out these matters in practice, than to writing upon them.

DISCUSSION.

Mr. **Beart** said he would briefly state his experience in his works during the last 15 or 20 years. About 1832, he first introduced machinery in connection with the manufacture of drain tiles, and particularly turned his attention to the subject now under notice. He then came to the conclusion that the great object to be attained in the manufacture, both of drain tiles and of bricks, was facility for drying the ware. The machinery to be employed in the manufacture was nothing more than that which the genius of individuals would apply to the particular circumstances under which they had to work. A machine which might be worked with advantage in one locality, would be of no use in another; but, as far as his own experience went, he had never found any difficulty in bringing machinery to bear under any circumstances in which he required it. The great difficulty he had experienced was in drying the material in the open air, and making brick works (which should be their object) not mere *brick-yards*, but *brick factories;* that was, that the process should be continuous, and go on from day to day throughout the whole year without interruption. He might state that, at the present time, and for the last two years past he possessed the means of drying 500,000 per week in the winter, and a much larger number—if required—in the summer time. In two works, during the last two years he had not been stopped in his operations for a single day; and therefore it might be supposed that he had paid no inconsiderable amount of attention to the subject of drying. He would briefly give them the result of his own experience in drying, which he regarded as the great desideratum in brick-making, and also in tile-making. When he commenced tile-making, in 1832, he had large sheds erected with shelves, which was the then system of drying; and these shelves, if extended in a straight line, would reach to a distance of 10 miles, and calculating 12 tiles to the yard, he had the means of keeping 200,000 tiles, as it were, in stock, in course of preparation, to go to the kilns as required: but with all these means he was only a summer manufacturer; it was a brick-yard, and not a brick-factory. He subsequently removed the whole of the shelves, and turned the whole of his sheds into hacks, and set the tiles one upon another, by which means he could dry 800,000 tiles if required. He continued that system up to 1842, from which period, he considered the improvements in brick manufacturing commenced, and his experience, after all, had proved that brickmaking was a question of drying. In 1850, he took out a patent for a particular description of drying shed, which had been partly explained by Mr. Chamberlain, but not quite correctly. The patent was confined to the construction of the flues with a certain inclination: the bricks were placed on trays and put in at one end of the flue, gradually descending until they came out at the other end. In these works he made use of stoves, and the heat passing entirely through the flue caused such an amount of ventilation that there was no accumulation of steam in the heating flues. Some persons had introduced the use of coal; but he had himself used coke for the purpose of heating, because, in the use of coal, the flues were liable to be choked up with soot. Where parties had introduced steam for the purposes of drying, they were quite right in using coals, because, instead of giving 18s. or 20s. a ton for coke, they could buy inferior coal in Staffordshire to generate steam at about 3s. a ton, and, therefore, steam in those districts was cheaper than the use of coke in flues for drying; but in his own neighbourhood, where he could buy coke at about the same price as coal, and coke containing more caloric than coal, he found it cheaper to use coke, while the process was more simple than by the employment of steam. Where steam, however, was used, the imperfection, he believed, in the steam apparatus, did not arise from a fault in the principle, but from a defect in the construction of the works by those who adopted steam without taking means to provide for the thorough ventilation of their flues. He agreed with almost everything which had been stated by Mr. Chamberlain on this subject. As he had before stated, his (Mr. Beart's) great object had been to make brick works factories—that instead of men being employed in the drudgery of making bricks, they should all be made by machinery. With regard to the railway of Messrs. Crosskill, he had never found it necessary to adopt any particular system of railway. He commenced by drawing the clay from the pits at various depths, from 20 to 60 feet. He simply laid a course of trams in the direction required, and laid down common contractors' rails, which were cheap, or simply bars of iron nailed on the timber, and by means of waggons on the trams the clay was brought to the rollers. After passing through the rollers it went into the clay chambers, thence to the machine, and from thence the bricks passed into the flues, then to the kilns, whence they were delivered into railway trucks; and thus a complete brick factory was established, the operations of which were continuous, let the weather be what it might. He now came to the question of burning the material. With regard to burning, small kilns, which would only burn 10,000 or 15,000 bricks at a time, would be of very little use to him, and he should find great difficulty in applying the waste heat of the kilns to drying the bricks in flues, from the great irregularity of the heat at different stages of the burning. Where they had a large establishment, producing 100,000 bricks per day, there would be great difficulty in dealing with this irregularity, because if they interrupted the drying, they interrupted the operations both of the machines and the men. They must have each department dependent upon the other, so as to form a continuous whole. Mr. Chamberlain had spoken of thirty-six hours for the drying and burning. He (Mr. Beart) was, however, placed in that position that it took eight days to anneal the goods before he could apply to them heat of an intense character, and then they must be burned for a period varying from 48 to 72 hours, in order to get the colour of bricks he had exhibited—one being red and the other white. In the clay he used there was a small quantity of oxide of iron, which, owing to the proportion of lime it contained, would sustain a certain degree of heat, until the oxide of iron was drawn off or precipitated. This clay produced the specimen of white brick before them. Bricks were also produced from the same kilns only partially marked with white. The action of fire upon bricks produced various effects in different localities. In Staffordshire, where they wanted a beautiful red colour, they placed the face of the bricks together in the kiln, and obtained the colour by preventing the fire from coming in contact with the bricks; but in Cambridgeshire, Huntingdonshire, Hertfordshire, and other localities, they could only produce the white colour required by the fire being brought into contact with the bricks. The action of fire was different upon different clays, and thus the colour required was produced. With regard to the crushing experiments which had been introduced in connection with this subject, he did not pretend to say that a perforated brick would bear an equal test to a solid brick, if the density of the two bricks were the same; but he would tell them, in his opinion, it was impossible to make bricks, of the density of the Worcestershire solid brick, commercially profitable. They had heard mentioned the different means made use of for compressing the bricks. If they made bricks under a great pressure, it had little to do with the density of the article. The density depended upon the clay being thoroughly broken down and rendered perfectly impalpable before it was made into bricks; because, if clay had moisture in it, they could not compress it to any advantage. Ordinary earthenware was far more dense than any description of brick, and yet it underwent no pressure whatever. In that case the clay was reduced to an impalpable state, and consolidated itself without any pressure, simply by contraction, drying, and turning. With regard to the so-called American system of making bricks by compression, which had been introduced into this country, he had been solicited, about twenty years ago, to adopt the same by Mr. Prosser, who took out a patent, which was called the "Adhesion of Cohesion," and which Messrs. Minton and Co. had, in a modified form, applied to the manufacture of tiles, buttons, and other articles. So far, therefore, from its being an American invention, it was only an old process patented in England; and by this process the manufacture of bricks was very expensive. If they had not to dry the bricks, they had to dry the soil of which they were made. They had also to grind and sift it, and to bring it to a state that it would work in the moulds. In the year 1833 or 1834, an American gentleman did introduce into this country a machine for compressing bricks in a partially-dried state. His system was, when the bricks were about half-dry, to stack them up until they became of an uniform state of dryness; by then passing them through moulds upon which great pressure was applied, a smooth surface was obtained, and, as little contraction took place afterwards, the form was perfectly retained. In conclusion, he would remark, that he considered the whole theory of the advancement of the brick trade must be, where the nature of the clay or soil would admit of it, to reduce the operation to that of a factory. In order to do that, the question was one of drying, and in this respect it was necessary to consider some of the natural laws which regulated the drying of the material. All plastic earths contracted in the drying from the surface—that was, they could not get the moisture from the interior of the brick before the outside contracted and fissures were formed. An illustration of this might be seen in a clod of earth in the summer-time; they would find on the outside fissures in which they could put their finger, but these did not extend to the interior. Therefore, difficult as was the question of drying bricks, but for the contraction which took place by the evaporation of moisture, the surface of the earth could not be cultivated.

Mr. **Axton** said he considered there were several objections to be made to Mr. Chamberlain's system, so far as regarded London. It might answer very well where coals were cheap, but this was not the case here. Assuming the number of bricks made in and about London to be two hundred millions, (and this, he believed, was a tolerably correct estimate), and allowing half-a ton of coals for each 1000 bricks, for drying and burning, the consumption of coals would be increased by one hundred thousand tons. This, he considered, would cause a material increase in the price of coals in the metropolis. By the existing method, not only was this enormous consumption of coals avoided, but, at the same time, all the refuse dust and ashes were profitably turned to account, and thus much noxious material was got rid of without difficulty and without cost. He also considered that the estimated waste for inferior bricks, &c., of 25 per cent., was too large, except when there was mismanagement, or the dust contractors adulterated the breeze and ashes by mixing with them materialsunfitted for the manufacture.

Mr. C. H. **Smith** said, although he was neither a brickmaker nor a bricklayer, still he had for many years past been a great deal connected with building. Much had been said in the paper as to the crushing power which bricks would sustain. He did not for a moment question the accuracy of the statements respecting the experiments made in the present instance, but he had reason to know, from experience, that the crushing power of this sort of material varied in different specimens of the same substance, and with regard to bricks the results could not be depended upon unless they were deduced from a number of experiments. One brick might crush at half the weight which another brick would sustain. He questioned the dependence to be placed upon experiments made with the hydraulic press. He thought great accuracy of calculation could not be obtained, as the slightest variation in any of the dimensions would affect very materially the result. He was inclined to think that the crushing power which bricks were capable of sustaining, with reference to their value for building purposes, was considerably over-rated. He was not aware of a single instance of what might be called a fair crushing of bricks or stone in a building. If the foundation gave way there might be a crack from top to bottom, but both those materials would bear a considerably greater weight than was required of them in a building. As a proof of that, he might instance the lowest pressure at which the bricks exhibited had been crushed, viz., 13 tons. By calculation they would find that in a building, even if the work were done in an inferior manner, 13 tons were considerably more than was wanted.

A **Gentleman**—To get 13 tons pressure upon a brick, the wall must be 2,000 feet high.

Mr. **Smith**, in illustration of his position, mentioned the fact that soon after the building of Waterloo-bridge some third and fourth-rate houses were built only a brick and half thick from a foundation considerably below the level of the bridge approaches, and carried at that thickness to a height of 94 feet, so as to form two houses one above the other, and yet there was no instance of the crushing of the bricks in those buildings, although some parts might have sunk. The weakest description of brick manufactured was the grey-stock, and that brick was quite strong enough for all the purposes for which it was employed. A great deal had also been said with regard to the weight of bricks. He did not think weight was a necessary qualification in a good brick. He considered a brick of 5lbs. weight (which was the average of the grey-stock) a perfect article as respected weight. The disadvantage of having very heavy bricks was the additional weight that had to be carried about before the bricks were placed in the building. This would add to the labour, and consequently to the cost of the building. Moreover, a workman would not be able to go through a day's work of ten hours lifting with one hand a brick of 8lbs. or 9lbs. weight. Whether there was any advantage in weight and density he had yet to learn.

Mr. **Henry Doulton** had listened with great interest to the two papers which had been read by Mr. Chamberlain, and particularly to the practical observations which had on each occasion followed from Mr. Beart, who so thoroughly understood the subject. He had been struck with the vast improvement that had taken place in the manufacture of bricks since the removal of the duty. The same remark would apply to the manufacture with which he was more especially connected (stone ware) since they had been relieved from the visits of the excise officer; and upon the same ground he apprehended a large field was opened for improvements in bricks of an ornamental character, although that operation might be said more properly to appertain to the potter's art. He had had considerable experience with regard to fire bricks, and he was persuaded that machine-made fire bricks—so far as that manufacture had been carried at present—did not answer so well as hand-made, nor was he aware of any manufacturer of fire bricks employing machinery for that purpose, although he knew several who had tried machines of various kinds, but they had not succeeded. At the same time, he believed the manufacturers generally would be glad to avail themselves of machinery if it could be adapted to their purposes. With regard to density, his experience had been, that fire bricks of great density would not stand so well as those of a more open character. He agreed in the remark of Mr. Beart, that too much importance was attached to the density imparted to machine-made bricks, and he could corroborate the statement of Mr. Beart that the great density of earthenware articles arose more from the manner in which the clay was prepared than from the mode of the manufacture. The better descriptions of pottery made upon the potter's wheel were far more dense than any machine-made brick, except they brought very great hydraulic pressure to bear upon it. The striking fact brought out in the report on the relative strength of different bricks in withstanding crushing power, viz., that of two bricks made of the same material and by the same machine, the hardest burnt withstood double the pressure of the softer brick, showed the importance of vitrification in enabling clay goods to withstand pressure. All the experiments went to confirm this. The Worcestershire brick, that withstood a pressure of upwards of 100 tons, was semi-vitrified; but it would not answer commercially to make bricks of that superior quality. He concurred in the remarks of Mr. Beart that the great object was, to convert the brick works into brick factories, for he had often been struck with the immense space occupied by brick-yards, which led him to the conclusion that it was an operation attended with great waste of space and labour; and he believed the plan sketched out by Mr. Beart would ere long be much more extensively adopted than was at present the case.

Mr. **Guilford Molesworth** said, the method adopted to crush the bricks, in the experiments detailed by Mr. Chamberlain, was by placing them on the follower of a powerful hydraulic press, and interposing a thin sheet of lead between them and the follower, another sheet of lead being placed above them. A cast-iron plate, so arranged as to adjust itself to the upper surface of the bricks, communicated the pressure to the bricks, so as to produce an uniform pressure over their whole surface, in the event of the upper sides not being exactly in a plane parallel to the top of the press. The surfaces of the bricks, both top and bottom, were carefully faced up with sand, to produce a flat surface and to remove all irregularities. The press used was nine inches in diameter, and the weights were applied at the end of a lever multiplying fifteen times, and acting upon a plunger one inch diameter. Every precaution was used to insure accuracy of result. The weights were suspended with the greatest care, and the lever allowed to sink to its bearing very gradually, to avoid any momentum which might vitiate the experiment. After a full bearing was obtained, the weight remained for a short time before more weight was added. It had been objected that the pressure exerted by a hydraulic press could not be calculated to such a nicety as when the lever alone was used, and that an inaccuracy of $\frac{1}{100}$th of an inch in the dimensions of the ram would produce an incorrect result. Mr. Molesworth agreed partly in this remark, but it should be remembered that the object of these experiments had been to determine the relative, not the absolute, strength of the bricks, and if such an inaccuracy did exist, it would exist equally in all the experiments, but the relative strength would not be affected by it. At the same time, he might observe that the press was a new one; that it was carefully made to the dimensions by Messrs. Cottam and Hallen, who were noted for precision and excellent workmanship, and such care was taken to ensure accuracy in all points, that though the absolute strain determined by these experiments must be considered approximate, he could confidently assert that that approximation was a close one.

Mr. Schwartz expressed an opinion that the strength of a building was not so much dependent upon the bricks as upon the mortar with which they were set, and a proper care in the outer joints of the work. He concurred in the opinion expressed by Mr. Smith, that bricks of great weight were not accompanied by corresponding advantages.

Mr. Beart remarked that he had heard the assertion that they could not profitably make bricks for cornices and such like purposes. He begged to state that at one of his works he manufactured that description of brick by machinery with edges as fine and perfect as in any of the bricks now before them. He had experienced no difficulty in the manufacture of ornamental bricks, and the only addition in price over that of the ordinary description of brick was about 2s. 6d. for the alteration of the mould necessary for the design. He had seen some very beautiful white cornice bricks manufactured at Rugby, which were brought to such perfection as to equal the finest stonework in appearance.

Mr. T. Scott was surprised that, while all the practical men who had spoken had indicated their knowledge of the fact that drying power was the primary essential in the manufacture of bricks and similar ware, none of them had mentioned the French *calorifère* as adapted to this purpose. It was a scientific and an easily regulated diffuser of heated air, and produced the desired results economically. Mr. Mechi, amongst others, used it for warming the workshops in which his men were employed, and he had told him (Mr. Scott), two years ago, that he could, by its aid, regulate the temperature of those rooms to a nicety. It was adopted by a drain-pipe and brick-manufacturer in Worcester, two or three years ago, to dry his goods, and the result had been most successful; and it was also, about two years since, introduced at some extensive government works, with which he (Mr. Scott) was concerned, and where several millions of drain-pipes had to be manufactured; and after some trouble and expense in adjustment, it now accomplished an amount of drying which could not be done in any other way that he was aware of. He was likewise surprised that Mr. Beart, who had, no doubt, an experience as extensive and varied as any man in this country, should state that the waste heat from a brick or tile kiln was of no value in drying such goods, "because it could not be regulated." Why, at the very works which he (Mr. Scott) had named, the waste heat was used most successfully as an adjunct to the *calorifère*, the smoke being first allowed to go off before the heat was turned under the drying-floors, and there was found to be no difficulty in ascertaining its effects by means of thermometers, and of regulating its action accordingly, by means of slide valves. The goods dried by this process were superior, when burned, to those dried in the open air. He had thought himself justified in stating these facts to the meeting, as he was not aware of any other impediment to an unlimited produce of bricks and drain-pipes from a sufficient bed of clay than the want of an unlimited and sufficiently cheap drying process. Mr. Chamberlain had shown his appreciation of this point by his elaborate reference to it in his paper; but another speaker had, with truth, emphatically reminded them that they must not neglect what nature did for this manufacture by means of sun and air, and which, after all, must continue to be the process of drying generally resorted to, throughout the country, by the numerous smaller makers of bricks and drain-pipes.

Mr. Dowell mentioned that he was abroad in November last, and witnessed a system of drying and burning bricks in a most successful and economical manner, which was now being experimented upon in this country. The cost of burning by the process to which he alluded was only 1s. 3d. per thousand, and the drying and burning were accomplished in twenty-four hours.

The Chairman.—Is the operation a secret?

Mr. Dowell said it was so at present, but in about six weeks' time he believed it would be made public. The process had been patented in this country.

Mr. C. H. Smith would mention, for the benefit of those who took an interest in testing the strength of materials, that Professor Eaton Hodgkinson was at present carrying on a series of experiments at University College, under the authority of government, with an apparatus constructed for the purpose upon the lever principle. He believed the test in that case would be much more accurately defined than was the case with the hydraulic press.

Mr. Chamberlain said he had great pleasure in making a few remarks on the practical discussion which had taken place. The employment of the waste heat of the kilns for drying the green ware was not so irregular as Mr. Beart imagined. There were 24 hours of a low heat when drying off, 48 hours of full heat, 24 while burning, and the first 24 hours cooling, and 24 more hours of a less heat during the completion of the cooling. Now, with this amount of heat, more than sufficient ware could be dried to again fill the kiln, and this at no extra cost. Mr. Beart had alluded to the density of china depending on the contraction of the clay in drying. He must, in this respect, differ from him, as the quality of that ware arose from the thorough vitrification of its particles when subjected to an intense heat. He was much pleased to hear from so practical a man as Mr. Beart, that he agreed in the opinion expressed in the paper that brick manufactorie should be established, and the primitive method of manufacture, now so universal, be abandoned. The pressure sustained by the solid bricks made by his machine, exceeded by 69 tons that borne by the perforated, made from the same clay and by the same machine, and was 104 tons more than a London stock-brick. This most completely refuted the theory of Mr. Clayton in the last discussion, when he said that bricks made from a screw machnie took a circular form, and, if the bricks were minutely examined after burning, they would not be found so sound. Now, this circular form or coils in the clay was, in his opinion, the source of strength; and it was the principle of working the clay in his machine which gave that great strength. The clay was powerfully compressed by the screw, then subjected to further pressure in its passage through the feeding die, and was then in that state in which other machines delivered the finished brick; but in his machine it had to undergo a still further pressure by being again compressed between the four driven rollers, and hence the great strength and density of the bricks produced by it. He could not answer this point last week, as Messrs. Horner and Molesworth had not completed their experiments, and, until yesterday, he was not aware of their great superiority. The perforated brick only sustained one-third the transverse strain of the solid. Now, with these proofs before him, he could venture to state, in the presence of London makers, that in this district of the country the quality of the brick was sacrificed to colour. If he had such bricks in his works as were commonly used in London he could not give them away. The weight of machine-made bricks was not so much more than the hand-made—a London stock-brick was only one-fifth less in weight than a machine brick per cubical contents. Before using them it was necessary to saturate the bricks with water, and the London stock-brick, being very porous, when charged, would be nearly equal in weight with the machine bricks. With the experiments for testing the bricks he had not in any way interfered; he certainly witnessed them, and must bear his testimony to the accuracy and care with which Messrs. Horner and Molesworth carried them out. These gentlemen applied to Prof. Hodgkinson to test the bricks on the table, but that gentleman was so much engaged that he could not undertake it. It had been remarked that bricks of the quality of those made by his machine could not be produced commercially at a profit. He might mention that they were the common bricks from the works of the Earl of Coventry, and were sold at a much lower price than the London bricks, though burnt with coals at 16s. per ton. The argument that the London brick was all that was required, was very fallacious. He imagined there were few gentlemen present, if building a house for themselves, who would not use sound strong bricks in preference to the inferior ware generally supplied, if they could be obtained on equally reasonable terms. The bricks were manufactured by the machine of this superior quality at one-half the cost of labour in hand-making, and hence realised a larger profit to the manufacturer. The quality of the bricks, he had before stated, depended on their density. Mr. Dowell would certainly confer a great boon on the trade if he could introduce a system of drying and burning in 24 hours, but he (Mr. Chamberlain) acknowledged he could not entertain such a proposition. He would refer to Mr. Beart, if, in his experience, bricks could be dried alone in less than 24 hours, much more burnt as well. The clay might be dried, but the rapidity of the process would so fracture the bricks that they would be of very inferior quality.

The thanks of the meeting having been conveyed to Mr. Chamberlain,

The Secretary announced that the Fifth Annual Institutes' Conference would take place on Monday, the 23rd of June, at 12 at noon; the One Hundred and Second Anniversary Dinner at the Crystal Palace on the 24th inst., at 5 p.m.; and the Annual General Meeting on the 25th inst., at 4 p.m.

Home Correspondence.

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REMARKS ON MR. CHAMBERLAIN'S PAPER ON BRICKMAKING BY MACHINERY.

Sir,—I beg to thank you for your kindness in sending me the last number of the *Journal of the Society of Arts*, containing the excellent paper on brickmaking by machinery, read by Mr. Chamberlain, on Wednesday evening, which I have perused with great interest, and much admire the candid way in which he has been pleased to speak of those machines which operate upon the clay in a semi-plastic state, as taken from the mine, and produce bricks in a state fit to be placed in the burning kilns immediately on leaving the machine.

In treating of this class of machinery, Mr. Chamberlain justly remarks that, 1st, They have to exert an immense amount of force in order to press the comparatively dry material into the moulds, so as to fill the corners, involving a great waste of motive power, and risk of damage to the machinery. 2nd. That the bricks are rendered imperfect by the expansion of those parts of their surfaces which are first relieved from pressure; and 3rd, That such machines are necessarily large and expensive.

As a rule, these remarks are correct, but had Mr. Chamberlain been acquainted with the principles of the machine which forms the subject of my last patent, he would, I think, have been constrained to admit that there is, at least, one exception to it.

Having, during the last six years, been engaged in a series of most expensive and laborious experiments, in surmounting the difficulties he enumerates, I trust a few remarks from me will not be deemed out of place in your *Journal*, more especially as the arguments on Wednesday evening appear to have been almost exclusively in favour of cutting machines.

The first objection I have succeeded in remedying, by giving to the column of clay, *ab initio*, a less sectional diameter than that of the mould into which it has to be driven, and forcing it, when properly prepared, into a space of a *greater* diameter than that of the screw which forces it; consequently, no "wire-drawing," or rolling out of the column is required, and by forcing this column through the moulding-boxes (which are open throughout) into a "rectum," or waste pipe, of the same shape and diameter as the die, a continuous stream of clay may be maintained for any length of time without occasioning any wasteful consumption of motive power, or undue strain upon machinery. So soon, however, as the moulds, which have a reciprocating action, are put in motion, the bricks are cut out of this column, right and left, the column which is in the waste pipe, and which acts as a safety-valve, being slightly protruded each time the mould becomes full, so that this machine combines, in reality, the principles of cutting and moulding.

The second objection is obviated by planing the bricks, on their mortar surfaces, "in transitu" to their point of delivery.

In reference to the third objection, I will only say that machines, capable of producing from 20 to 60 bricks per minute, fit to be placed in the kilns on leaving the machine, from clay which has not, in many instances, undergone any previous preparation, are supplied at from £150 to £180 each.

These machines have the great advantage of being applicable to every description of clay which is sufficiently dry, and to many from which it would be quite impossible to produce, by the cutting process, a brick fit for the market.

I fear I have trespassed too much upon your space, although I have so imperfectly described my principle, but should it be considered of sufficient importance, I shall be most happy to treat the invention more fully in a subsequent communication, or to demonstrate it before the Society at one of their meetings.

I have, &c.,

J. P. OATES, M.R.C.S.

Erdington, Birmingham,
June 9th, 1856.

ARRESTING FIRES.

Sir,—The suggestion of Mr. Murphy, for arresting fires by the use of salt water, which was printed in No. 185 of the Society's *Journal*, appears to me to be so valuable as to deserve further notice.

Every housewife is familiar with the *fact* that *salt* sprinkled on blazing coals *stops flame*, and hence its use to "make a clear fire." For the purpose of arresting fires, water saturated with alum will be found even superior to where salt is used, and I take the liberty to suggest (on Mr. Murphy's hint) that the tanks of water on her Majesty's Theatre and other buildings be saturated with alum, as, should the unfortunate necessity arise, whatever material the alum water falls upon will be rendered nearly incombustible.

Yours faithfully,
SEPTIMUS PIESSE.

2, New Bond-street.

TONNAGE REGISTRATION.

SIR,—In the *Journal of the Society of Arts* of May 30th I observe a second letter by Mr. Atherton, addressed originally to myself, and published in the *Mechanics' Magazine* of Saturday last. In the next number of that *Magazine* I intend to insert the subjoined remarks upon Mr. Atherton's letter, and I shall feel obliged if you will give place to them in your *Journal* of the 13th, in order that the question may not be left in an incomplete and partial form before your readers. As changes in the system of "tonnage registration" can only be effected by Parliamentary action, it is important that propositions designed to promote such changes should be freely and closely examined, and on that account your Society will, I doubt not, view the present discussion with interest. But for this consideration, I would not request you to transfer the following reply to your pages.

I am, Sir, your obedient servant,
THE EDITOR OF THE
MECHANICS' MAGAZINE.

166, Fleet-street, London, June 9th, 1856.

"In making a few comments on the letter in question, we beg again to assure Mr. Atherton that we entertain a very deep respect for his honesty of purpose, integrity, and capabilities, although we cannot give in our adhesion to all that he has written on Tonnage Registration. Our object in the remarks we have made on this question has been the elucidation and confirmation of truth. We took up Mr. Atherton's Essay in no hostile spirit—quite the contrary; but felt compelled, from our convictions (for which we have a right to claim as much honesty as Mr. Atherton would demand for his), to express our dissent from a considerable portion of it.

"Comparing the letter which we last week inserted with that Essay, we cannot help congratulating Mr. Atherton upon the manifest improvement which has taken place in his opinions, although they are still far from being faultless. We have, however, reason to complain of his mode of expressing himself on several occasions; probably the meaning conveyed to others is not that which was intended, but the effect is the same, whether intended or not. For instance, we are told that we are "*constrained* to acknowledge, and at the same time palliate the insufficiency of the law of 1854." Now, what is it that 'constrains' us to offer any opinion? Mr. Atherton's words would imply that we have put ourselves into the attitude of an advocate, and that we are *unwilling* to make any admission that might seem to tell for him. This is a gratuitously assumed conclusion on his part; and if he wishes credit for honesty—which we are by no means inclined to refuse—we may at least claim equal credit for it ourselves.

"Mr. Atherton complains that we, in common with many others, have misunderstood, and so misstated, the purpose of his paper, and have consequently attributed to him conclusions which he disavows. If this be so, he has no one to thank but himself for such misconceptions. For instance, it appears now that he had no fault to find with 'internal roomage' as one element of registration, and still less with the '*mode*' of measurement which he regards as a mere 'question of detail;' although he does entertain an opinion with regard to the relative merits of Mr. Peake's and Sterling's rule, about which we shall have something to say hereafter. Our notion of what Mr. Atherton meant was derived from such paragraphs as the following:—'In the first place, let us inquire what is the meaning of the term *tonnage*, as made use of in shipping registration under the now existing law, namely, the Mercantile Shipping Act of 1854? what matter of fact or measurable realities does the term tonnage signify? has the *tonnage* of a ship any specific relation either to the displacement of the ship or the nett tons weight of cargo the ship will carry, or the quantity of cargo a ship will hold? does the registered *tonnage* correctly answer any purpose as the base of calculation in commerce, *or as preventing fiscal* imposition? does it equitably constitute the base of building contracts? or answer any useful purpose in scientific inquiry, as affording elementary data available for determining the relative locomotive merits of ships? Finally, does the registration of *tonnage*, under the existing law, afford any information whereby cupidity and recklessness in the loading of ships can be officially exposed or checked in a manner conducive to the safety of property and life? Such are the points which we purpose inquiring into; and if the present system of tonnage registration dose not fulfil these requirements, it is purposed to submit to the consideration of the Society of Arts such suggestions as may conduce to the attainment of these objects.'

"We need scarcely observe that the paper consists in proving that the 'present system' does NOT fulfil these requirements, and suggestions are offered accordingly. As regards the *mode* of measurement, again, which we are now told is a mere matter of detail, our readers shall hear what Mr. Atherton has to say in the following passage, almost before he has fairly entered on his subject, and judge whether we have misstated him. 'Under this Act of 1854, a system of tonnage admeasurement, based on internal capacity, but reduced by a factor (divisor 100), in order that the aggregate of tonnage, as measured by this new law, might correspond with the aggregate, if measured by the old law, has now become the law of the land; and *although* this commission commenced its labours under the avowed and recorded declaration, 'that it is desirable to establish an easy practical mode of admeasurement,' the specification merely of the outline of the system of admeasurement, as prescribed by the Bill of 1854, occupies no less than ten clauses in the Act; and the detail of working out the calculations, to be properly understood and not done by rote, demands a course of laborious mathematical study. This system being merely the application of mathematical routine to the curvature of bodies, its accuracy may be admitted; but the prescribed detail of instructions to meet various sizes of ships and various peculiarities of construction have been made so multifarious as to complicate the application of the system, and to render the practical operation whereby the results are obtained a mystery, unintelligible to everybody excepting those who make it a professional study.'

"Pretty plain speaking this; and yet Mr. Atherton is astonished that Mr. Moorsom (not we) designated his paper a 'condemnatory harangue.'

"Again:—'The inveteracy of blind habit cannot be better illustrated than by the fact that the old rule for calculating tonnage, without reference either to depth of hold or draught of water, withstood the declared condemnation of several successive Parliamentary commissions, and continues to be pertinaciously made use of to regulate ship-building contracts, and the purchasing of ships in mercantile dealings, and even by Government authorities, though legally superseded in 1854 by Act 5 and 6 William IV., c. 56, which thus twenty years ago prescribed and legalised a totally new system of tonnage admeasurement based on ordinates, as hereinbefore referred to, which system failed to be popularly adopted on account of its complication; but nevertheless a far more complicated extension of the same system has now been introduced by the Merchant Shipping Bill of 1854. . . . Popular education has doubtless of late years made great progress; but still we have scarcely arrived at such a state of proficiency as to render it advisable that our tonnage admeasurement, so constantly put in requisition by every merchant, should be the solution of the mathematical problem for the *reduction of parallelopipedons by rectangular co-ordinates*. Were the new measurement of 1854 honestly called by this its proper name, it would not be listened to for one moment; the very name would expose it; but, instead of being thus designated, it is called Sterling's simple and easy system of admeasurement. Undoubtedly Sterling's reduction of parallelopipedons by rectangular co-ordinates, like the calculation of eclipses, may be simple and easy to those who perfectly understand it, but a mystery to those who do not, and very likely to be bungled by those who attempt to apply it in ignorance of the principles involved.'

"Such was Mr. Atherton's 'declared condemnation' of Sterling's rule on the 16th of January. On the 27th of May the same gentleman considers 'the *mode* of measurement a question of detail.' He has 'no desire to depreciate Sterling's rule,' and is surprised at our directing so much of our readers' attention to it. We congratulate him on his change of opinion, but we really must demur to his including this among the 'gratuitously assumed conclusions' which it appears we have been pleased to represent as the purport of his paper, and have so misstated his case.

"As regards his imputed attack on the shipping interests, we have already expressed our opinion that he intended no serious charge against them. He now denies that his words are capable of any such construction, and we do not doubt his sincerity in this declaration. Mr. Atherton, however, must have far less experience in the ways of the world than we give him credit for, if he is unaware that far more serious damage can be done to a reputation by an apt introduction of it into the company of characters about which there can be no mistake, than by any direct imputation. And we must say, that when, *a propos* to the subject of registration, *boroughmongering*, opposition to free trade, fraudulent declarations of dividends, to say nothing of the imputed corrupt resistance to reform by the professions of law, physic, and divinity, are brought upon the *tapis*, the shipping interests, who are not conscious of their imputed shortcoming, naturally feel aggrieved at being placed in such questionable, or rather unquestionable company. It is more in what is implied than in what is decidedly said, that the 'insult' was felt to consist. However, with the ample explanations of Mr. Atherton, the parties concerned would be unreasonable not to be satisfied.

"Our remarks, be it observed, went only to the point that the necessity and the advantage to the public of a change of registration had not been established on such reasonable grounds as to afford any parallel between the shipping interests and other notoriously corrupt bodies declining to petition for their own reform. But is it not assumed that this necessity and advantage have been incontestably established in the whole paragraph complained of—especially in the peroration?—'What right or reason, then, have we to expect that the shipping interests will voluntarily petition the legislature for an effective system of registration, *throwing open the mysteries of their craft with a view to the public good?*'

"Then, again, Mr. Atherton hardly states the case fairly, when, in disavowing the conclusions which have been erroneously attributed to him, he says, 'For instance, by my paper I did not object to internal roomage as one element of tonnage registration; but I upheld it as indispensable to a complete system of registration.'

"To state the case fairly, Mr. Atherton ought to have told us the *relative importance* of the registration of the 'internal roomage,' as at present by law established, and as it would be in accordance with his own suggestions. By the law of 1854, the internal roomage, divided by 100, constitutes the tonnage of the ship on which 'harbour dues, pilotage, light dues, and the like are to be assessed.' According to the proposed system, the registration of 'internal roomage' is of very minor importance, and might be entirely omitted with little or no inconvenience. It would scarcely be missed.' Mr. Atherton suggests in his paper that the 'builders' measurement, which is also to indicate the size of the ship on which the various dues are to be assessed, should be determined by taking the product of the external length and breadth as measured at the regulation deep draught-line water-line multiplied by the *internal* depth of the hold, and divided by 100,' corrected by a suitable factor, 'according as the intended ship may be proposed to be built with full lines burdensome for cargo, or finer lines more adapted to speed.' The *main* issue, therefore, is necessarily raised between these two measurements—for *fiscal* purposes; and as the greater part of Mr. Atherton's paper is directed against the established measurement *as suitable for this purpose*, we do not think that gentleman has much reason to complain of 'gratuitously assumed conclusions' on our part, or of the term 'condemnatory harangue' against the Merchant Shipping Law of 1854, applied to his paper by Mr. Moorsom.

"Any one perusing his letter in our last number, and not well acquainted with his original paper of January 16, would go away with the impression that he left internal measurement to perform pretty much the same functions as at present, only suggesting other matters 'in addition.' Whereas the real question is the much-vexed question between *external* and *internal* measurement as the basis for levying light and other dues!

"By-the-bye, as Mr. Atherton is so exacting in his requirement that the word tonnage, as made use of in shipping registration (and he will scarcely deny that levying dues is one of its principal uses), should 'signify' some 'matter of fact or measurable *reality*;' what 'matter of fact or measurable reality,' we may, in our turn, inquire, does the proposed builders' measurement represent, 'having *two external* elements and one *internal?*'

"As for the *admissions* which it seems we have made, and of which Mr. Atherton certainly is not inclined to throw away the benefit, we really went further than he states; we allowed that the present mode of measurement was only the *second best* resource of the Government, who had been foiled in their attempt to legalise an equitable system of external measurement. They fall, however, very far short of an admission of all the 'grounds on which 'Coryphæus the agitator based his condemnatory harangue.'' That worthy gentleman must have strangely forgotten his own paper—or must give credit to others for a very short memory—or he would tell our readers that the assumed encouragement to shipowners to dangerously overload their vessels held out by the present registration was one only among many other grounds on which his 'condemnatory harangue' was based. We have, for instance, first of all, the 'complication' of the rule itself, which was stated to be unintelligible to all but professional persons, and such as to render its application abortive; this, too, subsequently enlarged upon as we have already shown. Next, we had the 'assumed' misapplication' of the term 'tonnage' as applied to 'roomage,' and not to 'weight' burden. Thirdly, the assumed insufficiency of the guarantee given by the new rule, or 'inducement to builders tending to improvement in the form or build of shipping.' Fourthly, its incompetency to afford data for the comparison of the *locomotive* merits of ships—to say nothing of an 'assumed' ambiguity in the term tonnage itself as defined by law, which we showed to be a mere creation of Mr. Atherton's brain. All these points were jointly and severally, and 'verbosely,' aye, verbosely, descanted on, as most cogent reasons for substituting Mr. Atherton's propositions for the present law, which, if we are not egregiously mistaken, was the true purport of his paper. He now, however, limits his observations to one only of these points, viz., the encouragement given to the dangerous overloading of ships; on which ground, in consequence of our admissions, he thinks himself safe.

"He joins issue with us on our statement that a vessel of 1,000 registered tonnage may safely be considered by the owner to be capable of bearing 1,000 tons weight. This he answers by an 'assertion,' of the truth of which he gives us no means of judging, that the safe loading of two ships of the same nominal tonnage may vary in the proportion of 30 to 5, and that while one vessel of 1,000 tons may safely carry 1,500 tons weight of cargo, and in addition 1,500 tons by measurement of light cargo—in all 3,000 tons weight—another may safely carry only 500 tons weight. We may well let this assertion go for what it is worth; for our part, until we have some data in its favour to rely upon, we withhold our assent.

"A vessel of 1,000 registered tonnage has an *internal* capacity of 100,000 cubic feet. 1,500 *tons weight* of cargo represents a displacement of 52,200 cubic feet of water; and 15,000 tons of light cargo at 40 feet to the ton, represents a displacement also of 52,500 cubic feet; so that the whole displacement of such a vessel between the light and load draughts is 105,000 cubic feet—5,000 feet more than its internal measurement. To this we must make a considerable addition for the light displacement. The vessel in question must, therefore, have an *enormous difference* between its external and internal measurement—an unheard-of thickness of scantling to carry so much weight, and that too, at a safe distance below the deck! The other poor ship, which may carry 500 tons *weight*, is limited to a difference of displacement of 17,500 cubic feet; and yet their internal space is the same! *Credat Judæus!* Now, we have asserted that a ship of 1,000 nominal tonnage may be fairly reckoned upon for carrying 1,000 *tons weight* of goods. This is allowing only 35,000 cubic feet of sea-water for the displacement of such a vessel between the load and light draughts! This is so much within bounds that we might safely have ventured upon a higher figure.

"Mr. Atherton has made up his mind, however—in spite of the admissions of all men practically interested in this matter, that the present law does afford a fair basis for levying tolls—that this shall only be done at the price of safety. Nothing, then, will serve him but to represent our 'ships as sunk or water-logged, deck awash, full, it may be, of dead men's bones,' in order to secure equity in levying tolls—a precious condition of things indeed! which may be applicable enough for his model ship of 1000 nominal, but 3000 real tonnage, but which we utterly repudiate.

"It does not seem to have struck Mr. Atherton that possibly without sinking ships, there may be a *tolerably fair* proportion between the whole internal measurement and the displacement when fully loaded, not varying for different ships so much as 5 or even 2½ per cent.—the nearest approximation to correctness which he himself aims at.

"Now, with regard to fixing the load water-line, we are told that hundreds of ships are instanced by Fincham, in which the limit of draught or load-line, as proposed by the constructor, is specified and recorded in feet and inches as the contemplated limit of loading. Granted. A large proportion of these ships, unless our memory fails us, are vessels of war. Now we speak under correction, for we cannot expect to have the same information on this point as a Government officer, whose duties necessarily make him acquainted with these matters; but we are under the impression that the fixing of the load water-line is necessary in ships of war, not so much to create a limit for the safe loading as to keep the batteries at a proper distance above the water. We have heard it whispered—we still speak under correction—that it was not at all an uncommon thing, in the reign of the late surveyor of the navy, to hear of vessels constructed for a definite load-draught being immersed several feet beyond, and yet no danger, or suspicion of danger, to the *safety* of the ship resulted.

"In the case of merchant vessels, the constructor doubtless would consider that the ship, if immersed only as far as his proposed deep-draught water-line, would display her good qualities in the highest degree; but we question whether he would presume to say that it would be *dangerous* to load her more deeply. Indeed, we question whether it would be an easy matter to find a constructor who would take on his shoulders the responsibility of fixing such a limit. At all events we believe we are right in asserting that no such quality is now attached to the constructor's load water-line. That the *difficulty* (we do not say impossibility) of fixing a limit to the safe immersion of ships is real, and not entirely attributable to 'the cupidity of ship-owners and ship-charterers,' Mr. Atherton might have satisfied himself by the reflection, that, after all his inquiry and research, he is unable to suggest any nearer limit than one-*fourth*, or one-*fifth*, or one-*sixth* of the beam below the deck. We are left in a state of uncertainty whether in all cases the distance is proposed to be some *one* of these proportions, to be settled by 'consultative deliberation,' or whether all these are to be used according to circumstances. One would imagine, however, that a *long* ship, with comparatively small breadth, would, for safety, require the *water*-line at a greater distance below the deck than a shorter ship with a fuller beam. Mr. Atherton's suggestion, if adopted, would give exactly the opposite result.

"We repeat, we only instance this to show how difficult it must be to fix this line, since such is the only suggestion that has occurred to the mind of Mr. Atherton, who is giving anxious attention to the whole question.

"As regards the operation of the new law, Mr. Atherton has not touched the real point at issue. We maintain that the duty of government is to levy its tolls on vessels fairly, without giving an undue preference to any particular type of build. This is unquestionably done by the new system of basing these payments on the *actual internal measurement*. Whether a ship is built 'with full lines burdensome for cargo, or with finer lines more adapted for speed," its *exact* internal measurement is taken as the basis of levying the payments; and a builder or owner is therefore not obliged to think of anything but the form most suitable for his own purposes, in order to meet the requirements of the law. This surely is as much as can fairly be demanded.

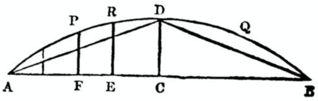
"We have now briefly discussed the principal points brought forward in Mr. Atherton's letter occasioned by our review; and again we congratulate him—on comparison of this with his former 'recorded' view—on the important modifications which have taken place in his opinion, which leave us room to hope that he may ultimately return to a sound state of mind on tonnage admeasurement.

"Our readers will remember how anxious Mr. Atherton was, that our note on tonnage measurement should be republished with all the corrections which had unfortunately been rendered necessary by its accidental admission without a final editorial revision. We, and probably our readers, expected some strictures on it. We are, however, gratified to find, that Mr. Atherton can find nothing to say against it. He qualifies this tacit approbation, however, by a comparison of it with 'Mr. Peake' system,' which we are told deserves the preference, on the score of superior applicability and facility of being mentally understood by the operator, and that it includes a closely approximate measurement of the curved spaces, whether convex or concave; whereas, by Sterling's rule, 'no notice whatever is taken of the curved portions above referred to; Peake's system is therefore the more correct of the two.'

"Now we do most sincerely trust that Mr. Atherton has formed his judgment on other questions brought prominently before the public in his paper, and his subsequent additions to it on more reliable data than he has brought to bear on this subject. We assert—and are ready to prove, if necessary—that Sterling's rule is applicable to the measurement of the curved spaces, whether convex or concave, by which the real form of a ship between the extremities of the ordinates of measurement differs from a straight line; and that, taking notice of these portions of the ship is by no means a peculiarity of 'Mr Peake's system.' We presume that the curve of sections, as explained in Mr. Peake's little work in Weale's Rudimentary Series, published in 1849, is that alluded to. At all events, we do not know of any other publication of his which contains a more elaborate exposition of his 'system,' or a different 'system.' For a complete elucidation of this mode of measurement, we refer our readers to p. 15 of the little work referred to.

"After the statements of Mr. Atherton, our readers will be surprised to hear that Mr. Peake divides the length of his ship into a definite number of *equal* parts, as usual, and takes the vertical sections at each of the points of the division, *the areas of which he calculates strictly in accordance with the received rule*. It is here that the divergence from the usual method takes place. He takes a base line, which he lays down to a certain scale, to denote the length of the ship, and at each point of division sets off lines at right angles to this to a fixed scale, proportional to, and therefore representative of, the areas; and through the extremities of these ordinates he draws a curve, which is the curve of sections. Now, with all this, we find no fault whatever. On the contrary, the representation of the solid contents of the ship by means of this curve is attended with several advantages. But the method by which that measurement is effected cannot so unreservedly meet with our approbation. The length being divided into two equal parts, and the ordinate to the curve drawn at the middle point, by joining the extremity of this ordinate with each extremity of the length, the figure is divided into two equal triangles, and two areas contained between the curve of sections and the chords before drawn. These two curvrlinear areas are considered as portions of common parabolas, and so the calculation is effected.

According to Sterling's rule, the curves drawn through the extremities of each of three consecutive ordinates is a parabola, which evidently gives a closer approximation than Mr. Peake's rule. Thus, if A B be the length, C its middle point, and C D proportionate to the area of the section at C, A P D Q B the curve of sections, the area A B D is divided by A D, B D, into two equal triangles, A C D, B C D, and two curvilinear areas, A P D, D Q B; these latter are supposed to be parabolas Now, it is evident that if A C be of considerable length, this supposition cannot be made without sensible error. If, however, E R, F P be two ordinates of the curve or 'representative areas' at moderate equal distances, C E, E F, P R D might be taken, without sensible error, to be a parabola; and so for other portions. Peake's method of curves of sections, so far as any peculiarity in the measurement goes, is therefore decidedly *less correct* than Sterling's rule. The independent measurement of the appendages, as they are called, *i.e.*, those portions of the vessel (as part of the stem, stern-post, and keel) which are not bounded by curves, belongs to no rule in particular



"Unless, therefore, we are grievously misinformed with respect to Mr. Peake's curve of sections, nothing can be more opposite to the truth than Mr. Atherton's ascription to the measurements made by means of it, as proposed by Mr. Peake, of the advantages of superior accuracy, applicability, and intelligibility. On the contrary, when the operator has once become familiar with the mode of calculating an area, (which he has to do for all the sectional areas on Mr. Peake's method), all he has to do by Sterling's rule, is to apply this same method for the summation of the areas to obtain the cubic contents; whereas Mr. Peake requires him to lay off the representative areas accurately to a scale, to draw a fair curve through them, and then to obtain the greatest distance between the two chords and the curve by trial; and all this to result in a measurement decidedly less accurate than would be obtained by following the usual rule.

"If we are mistaken in Mr. Peake's method, we shall be glad to have our error pointed out; but this is certainly what we gather from his little book in Weale's Series."—(*Mechanics' Magazine, June 14th*, 1856.)

PLAN FOR INTRODUCING DECIMAL COINS INTO OUR MONETARY SYSTEM.

Sir,—Permit me to occupy a short space in the *Journal*, to detail a practical plan for introducing decimal coins into our monetary system.

The difficulty which has to be encountered is, that one penny, or the 240th part of a pound, cannot be converted into a decimal fraction, and unless some system be adopted by which our present coins shall bear a definite relation to decimal coins, decimals must remain a bugbear to the million, and their use be unpopular, if not almost impossible, in practice.

The thought which has occurred to my mind, is to construct our decimal and present systems in definite relations, which shall be evident to the mind through the medium of the senses, so that by throwing two masses of coins upon the table, they may be sorted into the decimal and ordinary systems, and one may be rendered exactly equal to the other.

The decimal coinage might consist of the pound, the florin, the decat, and the mil.

The penny, however, cannot possibly bear any relation to this coinage, and we cannot afford to neglect the consideration of this coin, as probably 2,000 tons—and possibly 6,000 tons—of copper are in circulation over the country.

To meet this difficulty, a set of small copper coins should be issued, called the mite, half-mite, and quarter-mite; the mite having the value of the 1-6th of a mil. A penny would be equal to four mil and one mite, the halfpenny to two mils and half a mite, and the farthing to one mil and a quarter-mite.

By the conversion of our present money into mites, the untaught could always tangibly satisfy themselves of their mutual relations, and that by dividing the number of mites by six the result would be in decimal coins,

This mode of dealing with the question—which is applicable to weights and measures as well as money, has been forced upon my mind upon psychological grounds, based upon the properties of matter on the one hand, the powers of the mind on the other. In support of it I would refer to the statements of Mr. Bidder, the great mental calculator, who tells us that he satisfied himself of the properties of numbers through the medium of the senses, and that he made the multiplication table for himself by grouping sets of objects and counting them, thus demonstrating to his own mind that the multiplication table was an an absolute fact of universal application.

I remain, sir, your obedient servant,

ALFRED SMEE.

Bank of England, June 10, 1856.

Miscellanea.

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The Royal Society and the Government.—At a special meeting of the Royal Society, held on the 3rd inst., the following resolution was passed, on the motion of Sir Benjamin Brodie, seconded by Professor Bell:—"That the Council be authorised to accept and carry out the proposal of the Government, as to the occupation of Burlington-house, on the understanding that the hall, which it is proposed to construct in the west wing, and which is to contain the portraits belonging to the Royal Society, shall be placed in the custody of the Royal Society, subject to the free use of it by the senate of the University of London at all times at which it may be required for their examinations and public meetings." The library of the Royal Society now comprises 45,000 volumes. The Linnean Society and the Chemical Society will also have accommodation given to them in Burlington-house.

The Schools of Art and the Government Department of Science and Art.—The registrar, Mr. Norman Macleod, has had printed a list of the Schools of Art throughout the United Kingdom, in connection with the Department of Science and Art, completed to May, 1856. From this list the following abstract may be given:—Established as Schools of Design, between 1841 and 1852, nineteen local schools. Established as Schools of Art, since 1852, when the department was constituted,—in 1852, two schools; 1853, fourteen schools; 1854, fourteen schools; 1855, two schools; 1856, four schools—thirty-six schools: total, fifty-five schools; including the nine London district schools, sixty-four schools. Number of persons under art instruction in public schools, 18,198; in central schools, 9,041: grand total, 27,239 persons.

Experiments with Cast-Iron.—The interesting fact is developed by experiments of the U.S. Ordnance Department, that iron, by repeated fusion, up to a certain number of times, is thereby greatly improved in strength. Guns cast solidly, and those cast hollow, through which latter water was made to circulate after casting, showed an astonishing difference in their relative strength, the difference being in favour of the hollow-cast gun, which is attributed to the method of cooling, the solid gun, contracting from the outside, exerting a strain upon the arrangement of the particles of the metal in the same direction as the strain of the discharges. The experiments also showed that old castings are a great deal stronger than new: 8-inch guns, proved 30 days after being cast solid, stood about 72 charges; 34 days, 84 charges; 100 days, 731 charges; and 6 years, 2,582 charges. This phenomenon is accounted for by supposing that the particles strained in the cooling re-adjust themselves in the course of time to their new position, and become free, or nearly so.—*New York Paper.*

MEETINGS FOR THE ENSUING WEEK.

Mon. Architects, 8.
Chemical, 8 (last meeting of session), 1, Professor Abel, "On the Composition of some Foreign Varieties of Iron." 2, Mr. J. L. Wheeler, "On a New Carbon Battery."
Statistical, 8, 1, Renewed Discussion on Mr. Kendrik's paper "On the Loss sustained by Government in granting Annuities." 2, Dr. Samuel Fenwick, "On the Effects of Overcrowding and Want of Ventilation on Cholera."
Tues. Linnæan, 8.
Wed. Geological, 8, 1, Capt. Spratt, "On the Geology of Varna and its Vicinity." 2, Mr. J. Prestwich, "On the Correlation of the Middle Eocene Tertiaries of England, France, and Belgium."
Thurs. Antiquaries, 8.
Royal, 8½.
Sat. Asiatic, 2.
Royal Botanic, 3¾.
Asiatic, 8½, Lt.-Col. Sir H. C. Rawlinson, "On the Chaldeans."

PARLIAMENTARY REPORTS.

SESSIONAL PRINTED PAPERS.

Delivered on 5th June, 1856.

ar. No.

228. Foreign Legions—Copy of Conventions, &c.
235. Petty Sessions—Return.
242. Lunatics—Returns.
251. Music in Kensington Gardens—Copy of Correspondence.

Sessions 1854-55.

522. Titles, Contents, and Indexes to the Sessional Printed Papers.

Delivered on 6th June, 1856.

207. Proprietors (Scotland)—Returns.
215. Public Accounts (Audit Office)—Return.
160. Bills—Dissenters' Marriages (as amended in Committee, and on second and third Re-commitment).
161. Bills—Grand Juries.
162. Bills—Procedure before Justices (Scotland).

Delivered on 7th and 9th June, 1856.

228. Foreign Legions—Copy of Conventions, &c.
256. Railway and Canal Bills—3rd Report from General Committee.

190. Silver and Gold Wares—Report and Evidence.
203. Ramsgate Harbour—Copy of Sir W. Cubitt's Report.
159. Bills—Scientific and Literary Societies (amended).
163. Bills—Aldershot Camp (as amended by the Select Committee).
164. Bills—Oxford University.
165. Bills—National Gallery Site.
166. Bills—Insurance on Lives (Abatement of Income Tax)—Continuance.
167. Peace Preservation (Ireland).
Italy—Correspondence with Sardinia.
United States (Recruiting)—Papers.
Births, Deaths, and Marriages—17th Report of the Registrar General.

Delivered on 10th June, 1856.

219. Geological Survey—Return.
247. Indian Department (Canada)—Correspondence.
248. Museum of Practical Geology—Correspondence.
244. Transportation—1st Report from the Committee.
Costa Rica—Correspondence with the late Mr. Wallerstein.
Indian Law Commission—3rd Report.

Delivered on 11th June, 1856.

263. Sound Dues—Return
245. East India—Copy of a Minute by the Marquis of Dalhousie.
255. Capital Punishment (Colonies)—Return.
Indian Law Commission—4th Report.

PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette June 6th*, 1856.]

Dated 23rd January, 1856.

461. John Gedge, 4, Wellington-street South, Strand—Improvements in preparing and combining metallic substances for producing colours, and in manufacturing the same. (A communication.)
462. James Edward Boyd, Hither-green, Lewisham—Improvements in "scythes."

Dated 9th May, 1856.

1098. William Edward Wiley, 34, Great Hampton-street, Birmingham—Improvements in the manufacture of pens and penholders.
1104. Frederick Richard Laurence, Southampton-street—Improvement in the manufacture of shirt collars and wristbands.

Dated 14th May, 1856.

1139. Gustavus Palmer Harding, Kingsland—Improvement in the manufacture of cloth bonnets.

Dated 16th May, 1856.

1159. William Thistlethwaite, 2, Verulam-buildings, Gray's-inn—Improvements in photography. (A communication.)
1161. William Harker, Victoria Mill, Bowley, Bradford—Improvements in giving motion to rotating shuttle boxes of power looms.
1163. Edmund Eaborn and Matthew Robinson, Clement-street, Birmingham—Improvements in machinery for grinding or reducing sugar.
1165. James Mellor, Gorton, near Manchester—Improvements in grates or grids, applicable to sewers, drains, and other similar purposes.

Dated 17th May, 1856.

1167. David Curwood, George-street, Grosvenor-square—Improved apparatus for facilitating the cleaning of knives and forks.
1169. Alfred Vincent Newton, 66, Chancery-lane—Improvements in machinery for forging or pointing wrought nails, spikes, and other four-sided articles. (A communication.)
1171. Louis Cornides, 4, Trafalgar-square—Improvements in ornamental window blinds, and such like transparent decorations.
1173. John Hynam, 6 and 7, Princes-square, Wilson-street, Finsbury—Improvement in the manufacture of instantaneous lights when of paper or cotton.
1175. Richard Knight, Foster-lane—Improvements in apparatus for ærating liquids.
1177. Lieutenant-Colonel Charles Carroll Tevis, Paris—Improved revolver.

Dated 19th May, 1856.

1179. John Wilkes, Thomas Wilkes, and Gilbert Wilkes, Birmingham—Improved manufacture of rollers or cylinders for printing fabrics.
1181. John Leakey Bowhay, Modbury—Improvements in drills for sowing seeds and distributing manure or water.
1183. Moses Haym Picciotto, 8, Crosby-square—Improvements in preparing flax, hemp, and other similar fibrous materials.
1185. John Wilkes, Thomas Wilkes, and Gilbert Wilkes, Birmingham—Improved manufacture of rollers or cylinders for printing fabrics.

Dated 20th May, 1856.

1186. William Fowler and William McCollin, Kingston-upon-Hull—Improvements in portable steam-engines, applicable to agricultural and other similar purposes.
1187. William Maugham, Ifield-terrace, Surrey—Improvement in rendering wood fire-proof.
1189. William Maugham, Ifield-terrace, Surrey—Improvement in rendering cotton and other fabrics and paper uninflammable.
1190. Richard Maxwell, 4, Carlton-terrace, North Brixton—Improvements in the construction of taps for drawing off liquids.
1191. James Anning Gollop, 74, Lower Sloane-street, Chelsea—Improved method of excluding dust, water, air, and other extraneous matters from doors, windows, glass, show cases, and such like constructions.
1192. Samuel Rogers Toms, 3, Church-villas, Croydon—Improvements in gloves.
1193. William Cardwell McBride, Armagh—Improvements in machinery for scutching flax and other vegetable fibrous substances.
1194. Alfred Vincent Newton, 66, Chancery-lane—Improved mode of preparing the double chlorides of aluminium and sodium, and aluminium and potassium. (A communication.)
1195. William Edward Newton, 66, Chancery-lane—Improvements in the process of manufacturing oil from seeds, and in the machinery and apparatus to be used therein. (A communication.)
1196. Alfred Vincent Newton, 66, Chancery-lane—Improved rotary pump. (A communication.)

Dated 21st May, 1856.

1197. Joseph Henry Reynell de Castro, Manchester—Improved method of propelling railway or other carriages up inclines. (A communication.)
1198. David Shaw, Gee-cross, Chester—Improvements in looms and apparatus employed therewith for weaving.
1200. John Perron, 53, Buddesland-street, Hoxton New-town—Improvements in ornamenting surfaces of wood, ivory, bone, and such like substances.
1201. Alexandre Henri Dufresne, 39, Rue de l'Echiquier, Paris—Improved process of gilding and ornamenting steel and other metals.
1202. John Cope, Birmingham—Improvement or improvements in the manufacture of buttons made of pearl or other shell, ivory, bone, or wood.
1203. Manoah Bower and John Barwell, Birmingham—Improved method of joining the parts of metallic and other bedsteads and other articles of furniture.
1204. Henry Medlock, 20, Great Marlborough-street—Improvements in the manufacture of glass, enamels, and other vitrified substances.
1205. James Holdin and William John Dorning, Manchester—Improvements in bouking, bleaching, washing, and cleansing textile fabrics and materials. (Partly a communication.)
1206. Alexander Allan, Perth, and Thomas Hunt, Crewe—Improvements in the construction of locomotive and other steam engines and carriages, and in the rolling stock of railways.
1207. George Heron, South-street, Newcastle-on-Tyne—Improvements in machinery or apparatus for raising, lowering, moving, or transporting heavy bodies.
1208. Rudolph Hermann Schwabe, Glasgow—Improvements in the manufacture or production of ornamental fabrics.
1209. Macleroy Neilson, Thorn Mill, Renfrew, N.B.—Improvements in the treatment, preparation, or finishing of yarns or threads.
1210. Edward Greenlees, Glasgow—Improvements in the treatment and preparation or manufacture of textile and pulpy materials.
1211. Charles de Jongh, Lautenbach, near Guebwiller, France—Improved method of separating and assorting combed fibres of different lengths.
1212. Thomas Lawrence, Birmingham—Improvements in machinery to be used for grinding and polishing gun barrels, swords, matchets, bayonets, scythes, fire irons, and other articles similar in transverse section to any of those above named.
1213. Edward Hammond Bentall, Heybridge, Essex—Improved machinery for crushing or splitting grain or seeds. (A communication.)
1214. William Edward Newton, 66, Chancery-lane—Improvements in machinery for spinning or twisting fibrous substances. (A communication.)
1215. William Henry Aston and Samuel Hopkinson, Zetland Mill, Huddersfield—Improvements in steam-boiler furnaces and apparatus employed for supplying water to steam-boilers.
1216. William Joseph Curtis, 1, Sebbon-street, Islington—Improvements in the manufacture of iron railway wheels.

Dated 22nd May, 1856.

1217. William Galloway and John Galloway, Manchester—Improvements in steam boilers.
1218. Alexandre Hubert, Capt. in the Navy, Bordeaux—Improved apparatus for ventilating ships or vessels.
1219. John Charles Pearce, Bowling Iron Works, near Bradford—Improvements in apparatus for generating and economising steam.
1220. William Richelieu Hodges, Manchester—Improvements in machinery or apparatus for manufacturing loop-pile fabrics. (A communication.)
1222. Alexandre Tolhausen, 7, Duke-street, Adelphi—Improvements in clock-work, part of these improvements being applicable to other regulating purposes. (A communication.)
1223. Job Cutler, Sparkbrook, Birmingham—Improvements in the manufacture of metallic pipes or tubes to be used for various purposes.

1225. Germain Barruel, 24, Rue Hautefeuille, Paris—Improvements in treating cotton seed.

1226. Robert Bell, 93, Glassford street, Glasgow—Improvement in the manufacture or production of ornamental fabrics.

1227. Charles Dewick, senr., Stanley-street, Leicester—Improvements in machines, generally called "rib frame or rib machine," for producing fancy hosiery.

1228. James Howard, Bedford, and George Williams Baker, Woburn—Improvements in machinery or apparatus applicable to the tilling of land.

Dated 23*rd May*, 1856.

1229. Thomas Dawson Russum, Tipton—Improved brake for steam engines and other motive power engines.

1230. Samuel Berrisford, Portwood, near Stockport, and Enoch Wilkinson, Oldham—Improvements in looms for weaving.

1231. John Gedge, 4, Wellington-street South, Strand—Improved gridiron. (A communication.)

1232. John Gedge, 4, Wellington-street South, Strand—Improvements in looms. (A communication.)

1233. John Gedge, 4, Wellington-street South, Strand—Improvements in machinery or apparatus for winding threads. (A communication.)

1234. John Gedge, 4, Wellington-street South, Strand—Improvements in obtaining a material used in dyeing. (A communication.)

1235. John Gedge, 4, Wellington-street South, Strand—Improvements in machinery or apparatus for the manufacture of billiard cues or similar articles. (A communication.)

1237. John Gedge, 4, Wellington-street South, Strand—Improvements in the application of distillation to gas from the furnaces of steam engines. (A communication.)

1238. George Bell Galloway, 42, Basinghall street—Improvements in the furnaces of marine boilers, and in the construction of steam vessels.

1239. Thomas Herbert and Edward Whitaker, Nottingham—Improvement in the manufacture of warp lace fabrics.

1240. John Dixon, High Bridge, Newcastle-upon-Tyne—Improvements in apparatus for measuring water and other liquids.

1241. Frederick Peter Dimpfel, Philadelphia—Improvements in the construction of screw nuts for axle-boxes, and other purposes. (A communication.)

Dated 24*th May*, 1856.

1242. John de Cockkenifeck, Cork—Improved process and apparatus for preparing, refining, and filtering oils or fatty matters.

1243. Pierse Eustace Laurence Barron, Coleshill-street, Eaton-square—Improved process for coating metals for sheathing ships and for other purposes, and in the means of attaching sheathing plates to ships or vessels. (A communication.)

1244. William Illingworth, Manchester—Improvements in printing or colouring and glazing china, earthenware, or other ceramic manufactures, and in the machinery or apparatus connected therewith, and also improvements in the subsequent treatment of such manufactures.

1246. Robert Adam Whytlaw and Alexander Mitchell, jun., Glasgow—Improvements in weaving.

1247. James Lea, Birmingham—Improvements in sun blinds.

1248. Frederick Peter Dimpfel, Philadelphia—Improvements in the construction of steam boilers and furnaces.

1249. Samuel Davey Liptrap, Albany-road, Camberwell, and James Wright, 10, Alfred-place, Newington Causeway—Improvements in apparatus for regulating the mode of supplying and drawing off water and other liquids.

Dated 26*th May*, 1856.

1250. Benjamin Nadault de Buffon, 13, Rue du Cherche Midi, Paris—A new apparatus for clarifying and purifying water and other liquids.

1252. Alphonse René le Mire de Normandy, 67, Judd-street, Brunswick-square—Improvements in obtaining fresh water from salt water.

1853. Wharton Rye, Manchester—Improvements in fixing or fastening rails or railways in their chairs.

1254. William Hulse, Birmingham—Improvements in metallic and other bedsteads, which improvement or improvements may be applied to other articles of furniture, and to framework generally.

1255. Charles Cowper, 20, Southampton-buildings, Chancery-lane—Improvements in the treatment of coal, and in the purification, dessication, and agglomeration of coal, and in machinery and apparatus for such purposes. (A communication.)

1256. Bennett Johns Heywood, Leicester-square—Improvements in holders for leads, slate, and other marking materials.

1257. Frederick Charles Jeune, Gresham-street—Improved manufacture of floor-cloth.

1258. William Edward Newton, 66, Chancery-lane—Improvement applicable to quadrants and other instruments for taking the altitude of the sun or other objects. (A communication.)

1259. Thomas Foster, Brownlow-street—Improved apparatus for holding postage, receipt, and other stamps.

1260. Samuel Newington, M.D., Ticehurst—A preparation for destroying the fly or aphis, and other insects, on hop and other plants.

1261. John Roberts, Falmouth—Improvements in machinery for moulding bricks and tiles.

1262. Thomas Charlton, Brentwood, and William Turnbull, Rotherhithe—Improvements in steam-engines.

1263. James Baird, Edinburgh—A method of freeing the wool upon skins from burrs and other extraneous substances.

1264. Henry George Yates, East Smithfield—Improvement in treating wash waters in order to precipitate the greasy and soapy matters contained therein. (A communication.)

Dated 27*th May*, 1856.

1265. Ebenezer Talbott, Spring Vale, Staffordshire—Improvements in the construction of rails for railways.

1266. Frank Clarke Hills, Deptford—Improvements in the purification of gas.

1267. William Edward Newton, 66, Chancery-lane—Improvements in printing machinery. (A communication.)

1269. Frederick Peter Dimpfel, Philadelphia—Improvements in constructing the permanent way of railroads.

INVENTION WITH COMPLETE SPECIFICATION FILED.

1288. William Needham and James Kite, Vauxhall—Improvements in machinery or apparatus for expressing liquids or moisture from substances.—31st May, 1856.

WEEKLY LIST OF PATENTS SEALED.

Sealed June 6*th*, 1856.

2621. George Senior Tolson, Robert Henry Tolson, and Joseph Senior Tolson, and Thomas Irving.

2741. Jonas Marland and Samuel Marland.

2743. William George Wilson.

2751. Thomas Chaffer and Jonah Ellis.

2752. Johannes Neuenschwander.

2758. Jean Joseph Emilien François Kuister.

2809. Robert Midgley and George Collier.

2871. Richard Ruston.

2897. Charles Glover.

2919. Alexandre Tolhausen.

2934. John Robinson and Richard Cunliffe and Joseph Anthony Collett.

2950. Thomas Holmes.

63. Peter Armand le Compte de Fontaine-moreau.

84. Thomas Charles Clarkson.

269. Thomas Hurst.

270. John Henry Johnson.

572. David Brown and William Brown.

604. George Murray.

650. Lazare Ochs.

720. Thomas Barnabas Daft.

731. Joseph Tall.

770. Benjamin Looker, jun.

776. Henry Gornforth.

Sealed June 10*th*, 1856.

2780. John Hall., jun.

2784. David Parsons.

2790. Bernard Hughes.

2791. Bernard Hughes.

2793. Jean Marie Préaud.

2806. Martin Billing and Walter George Whitehead.

2814. David Hart.

2823. John Walter Friend.

2827. Charles John Todd and Robert Pinkney.

2829. Peter Haworth and Alexander Forrest.

2833. John Aspinall.

2834. Edward Brown Hutchinson.

2836. George Coats.

2842. Paul Marie Salomon, Jacques Loir Montagazan, and Charles Marie Joseph de Flers.

2844. George Collier and John Crossley, and James William Crossley.

2846. Henry Stewart.

2847. John Lobb Jeffree.

2870. George Ross and Thomas Wilkes.

887. David Dunne Kyle.

2899. John Gedge.

2901. James Newman and William Whittle.

2932. John Grist.

2942. Lewis Harrop, Samuel Barlow, and Alexander Boyd.

2951. William Edward Newton.

33. Robert Grey.

206. William Owen.

PATENTS ON WHICH THE THIRD YEAR'S STAMP DUTY HAS BEEN PAID.

June 2nd.

1422. Richard Archibald Brooman.

June 4th.

1391. Christopher Nickels and James Hobson.

1404. John Horrocks, jun., and James Dunlop Horrocks.

June 6th.

1416. James Robert Napier and William John Mackquorn Rankine.

1445. Arthur Parsey.

June 7th.

1409. Claude Arnoux.

WEEKLY LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

No. in the Register.	Date of Registration.	Title.	Proprietors' Name.	Address.
3845	June 6.	Live Ring Turntable	J. E. McConnell	Wolverton.
3846	,, 6.	Improved Shirt Front and Collar	John Paterson	104, Wood-street, Cheapside.
3847	,, 6.	The Service Canteen	Lieut. Philip Harris	H.M. Royal Marines, Chatham.
3848	,, 7.	Portable Watercloset	John C. Stokes	Birmingham.
3849	,, 11.	Improved Magneto-Electric Machine	John B. Dancer	Manchester.